Research Update: Growing Almonds

December 8, 2015

Speakers

Bob Curtis, Almond Board (Moderator)

David Smart, University of California, Davis

Alissa Kendall, University of California, Davis

Bruce Lampinen, University of California, Davis

Malli Aradhya, USDA-ARS, Davis, CA

Katherine Pope, UCCE – Yolo, Solano, Sacramento Counties

Luke Milliron, University of California, Davis

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Bob Curtis, Almond Board

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David Smart,
University of California, Davis

N_2O Emissions From Almond

David R. Smart, Sharon Dabach, Rebekah Davis, Maria del Mar Alsina and Daniel Schellenberg

University of California, Davis

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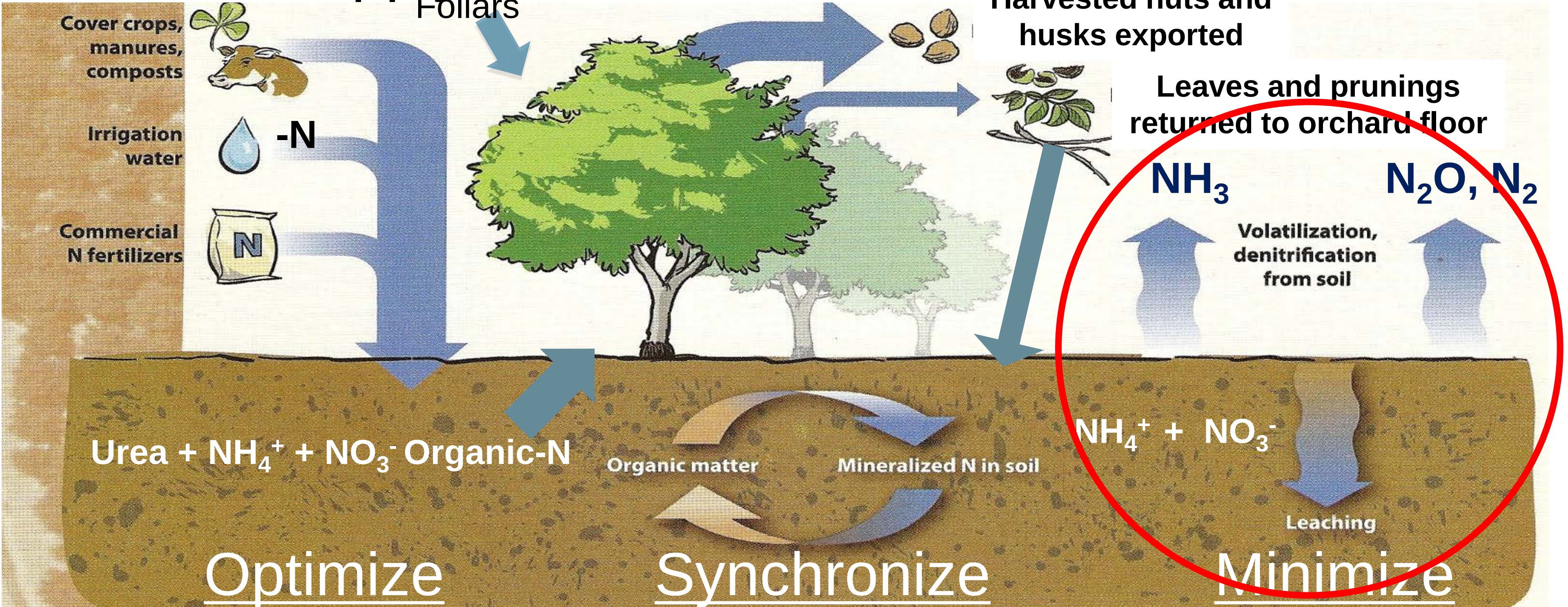
N-Supply N-Demand N-Loss



BMP Treatments:

Advanced Grower Practice (AGP)
(split applications targeted to N demand)

High Frequency Low [N] (HFLC)
(spoon feed, 20 split apps of 5-15 lbs $acre^{-1}$)

Pump and Fertilize (P&F)
(AGP, compensating for well water N loads)

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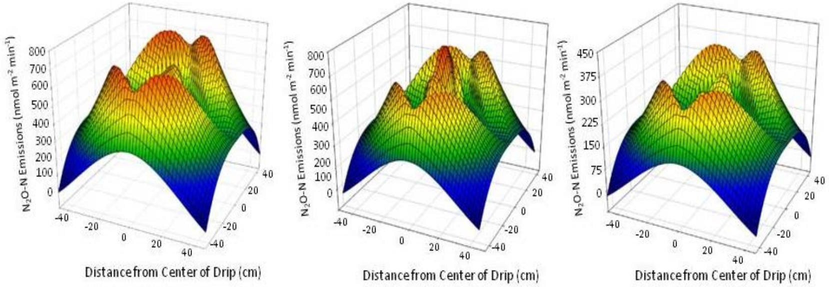
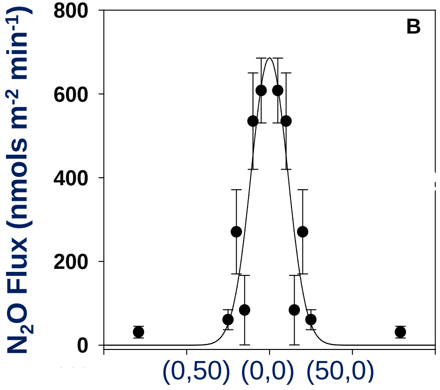
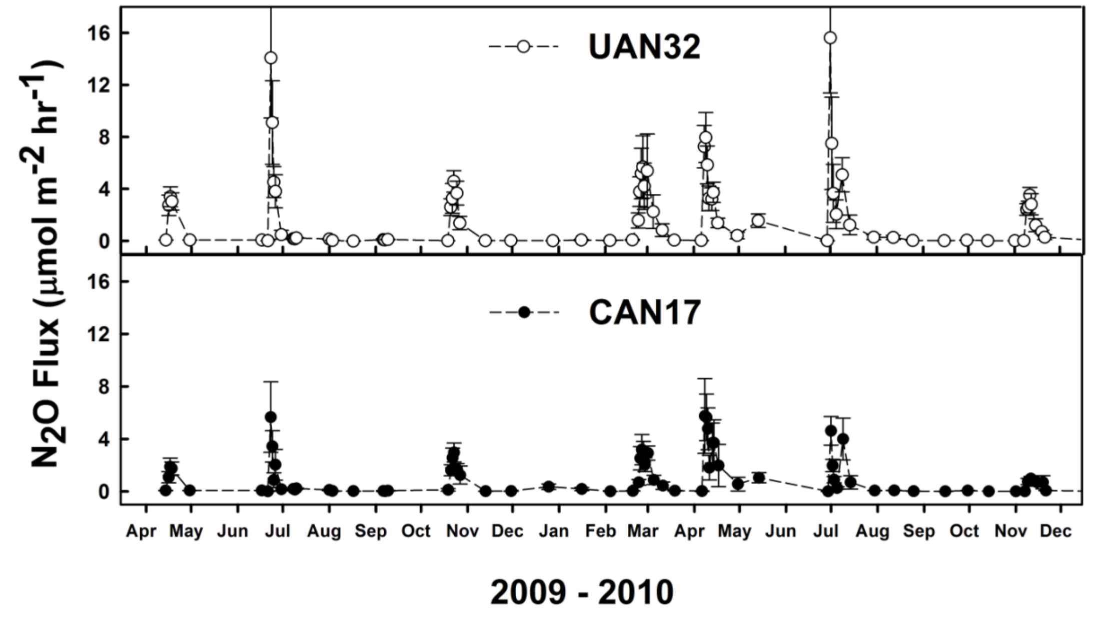
Spatially Modeling N_2O Emissions





$$\iint_A f(x,y)dxdy \cong \sum_{x=-0.5}^{x=+0.5} \sum_{y=-0.5}^{y=+0.5} y_o + y\; a \cdot e^{\frac{1}{2}\left[\frac{(x-x_0)^2}{b^2}+\frac{(y-y_0)^2}{c^2}\right]}$$

Scaling to Seasonal N_2O:



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	Almond (lb/acre)			Pistachio (lb/acre)		
	AGP	HFLC	P&F	AGP	HFLC	P&F
Yield (kernels)	2699	2869	2695	2837	2869	2668
Groundwater-N	73.8	73.8	73.8	14.3	14.3	14.3
Fertilizer-N	215	215	186	174	166	161
Compost-N*	2	2	2	2	2	2
Kernel-N	119	130	112	79	80	75
Storage-N (wood)	25	25	25	25	25	25
N in Hulls	67	72	67	5	5	5
N_2O-N Loss	0.65	0.29	0.54	na	na	na
NUE	0.72	0.78	0.77	0.57	0.61	0.59

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Kernel-N	119	130	112	79	80	75
Storage-N (wood)	25	25	25	25	25	25
N in Hulls	67	72	67	5	5	5
N_2O-N loss (CO_2 eq)	62.1	27.9	51.2	62.1	27.9	51.2
NUE	0.51	0.69	0.59	0.25	0.45	0.30

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Conclusions:

- In general, N_2O emissions from almond and pistachio orchards in the arid West are much lower than for other crops.
- Only the HFLC N, “spoonfeed”, N application treatment lowered emissions of the greenhouse gas N_2O. When factored into NUE calculations, showed slightly superior CA emission factor.
- In terms of lowering carbon offsets, we still have some work to do in terms of identifying Best Management Practices.



Alissa Kendall,
University of California, Davis

Life Cycle Assessment of GHG Emissions for Almond Processing and Distribution

Alissa Kendall, UC Davis (amkendall@ucdavis.edu)
Sonja Brodt, UC Davis
Katherine Hoeberling, UC Davis

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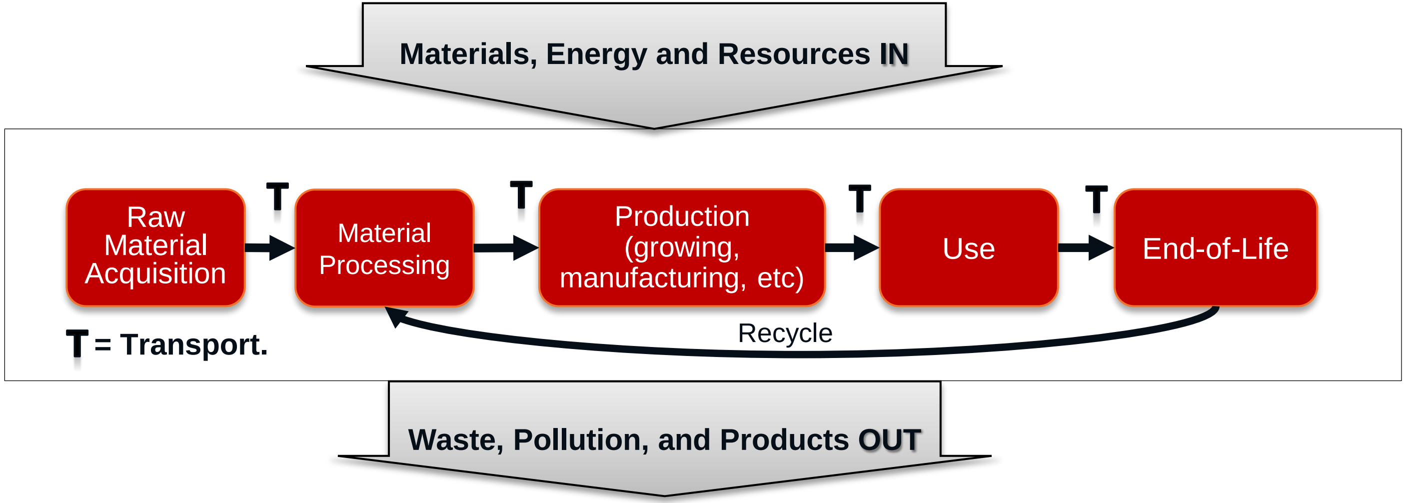
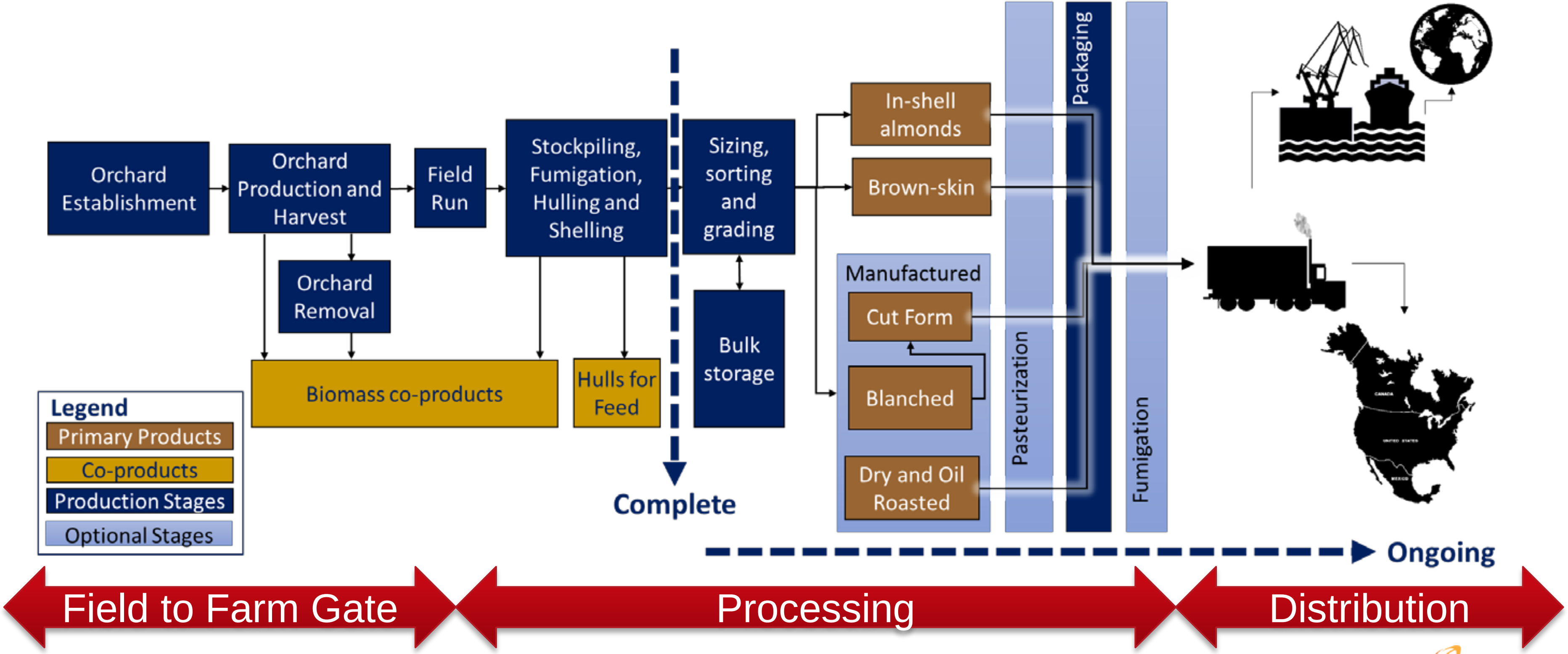
Life Cycle Assessment (LCA)

- A method for characterizing, quantifying, and interpreting environmental flows for a product or service from a "cradle-to-grave" perspective.
- In our study we examine energy, greenhouse gas emissions, criteria pollutants, and direct water use.



Scope of our LCA study



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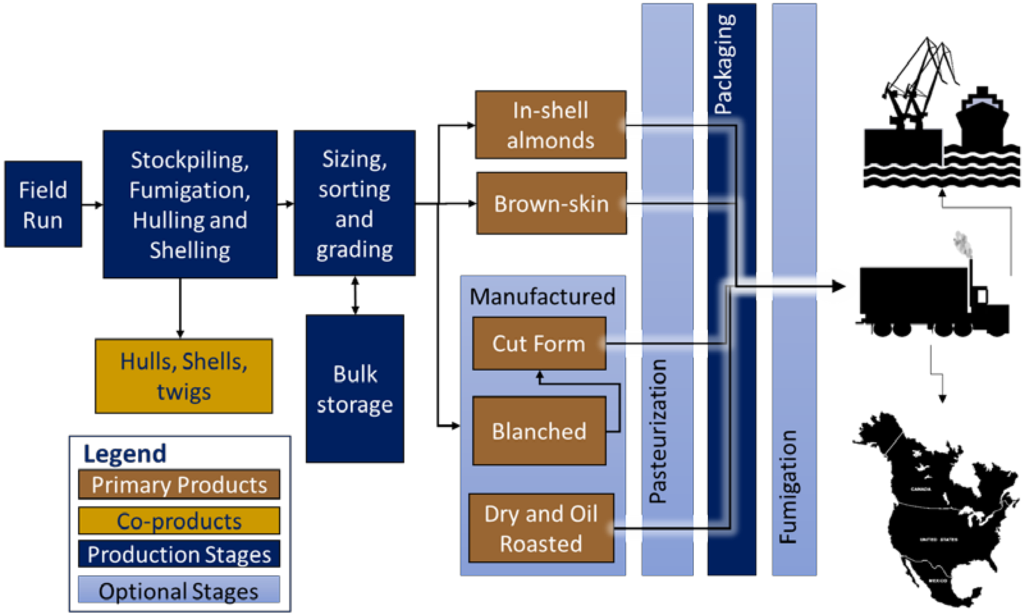
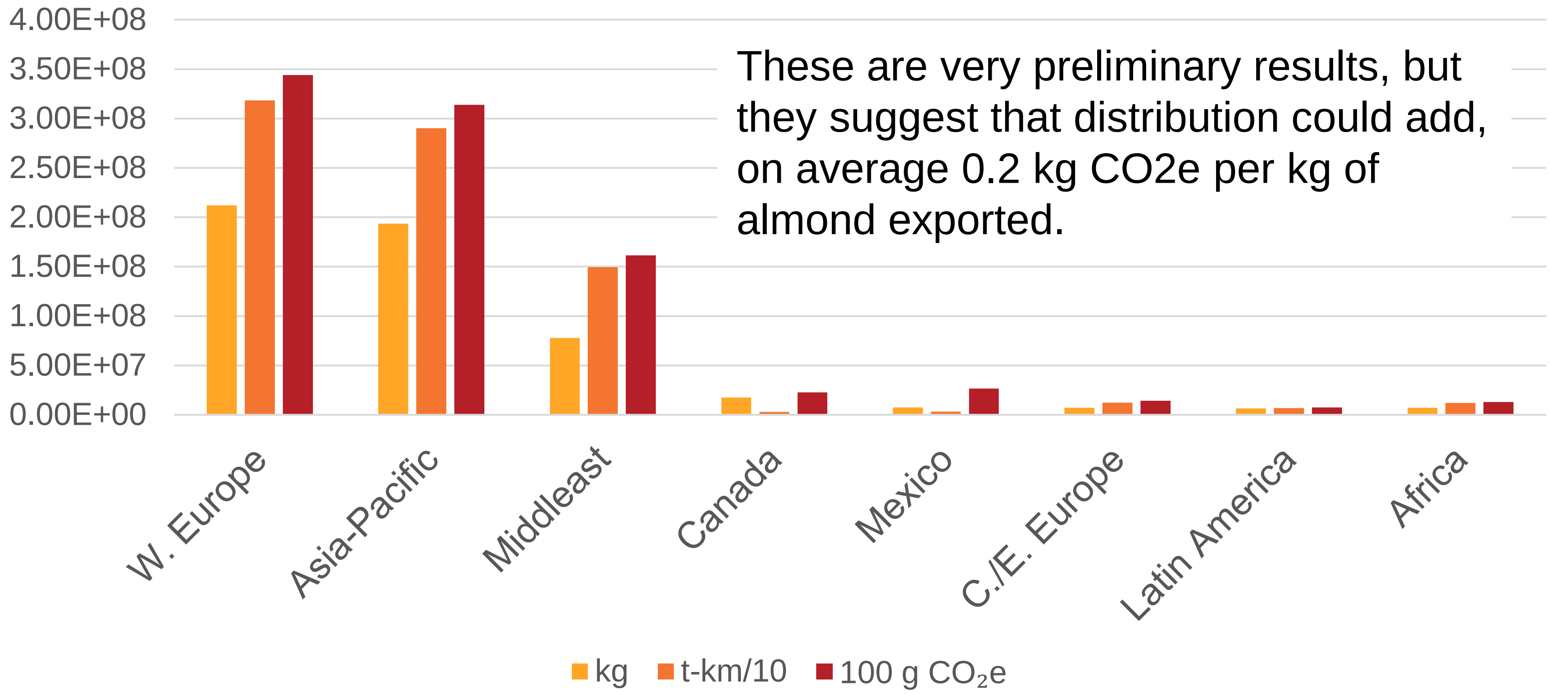
Processing and Distribution Modeling Progress

- Processing: Data collection is on-going
  - Data collection through questionnaires and in-person interviews.
    - "Black Box" approach – where we collect data on total inputs and total outputs from a facility
    - Process approach- where we model process steps so we can identify specific "hotspots" for energy use or emissions
    - We need a sufficient number of processors so we can present research results without identifying processor information
- Distribution: Based on data from position reports and best-route decisions for shipping
  - Preliminary calculations are complete for life cycle impacts

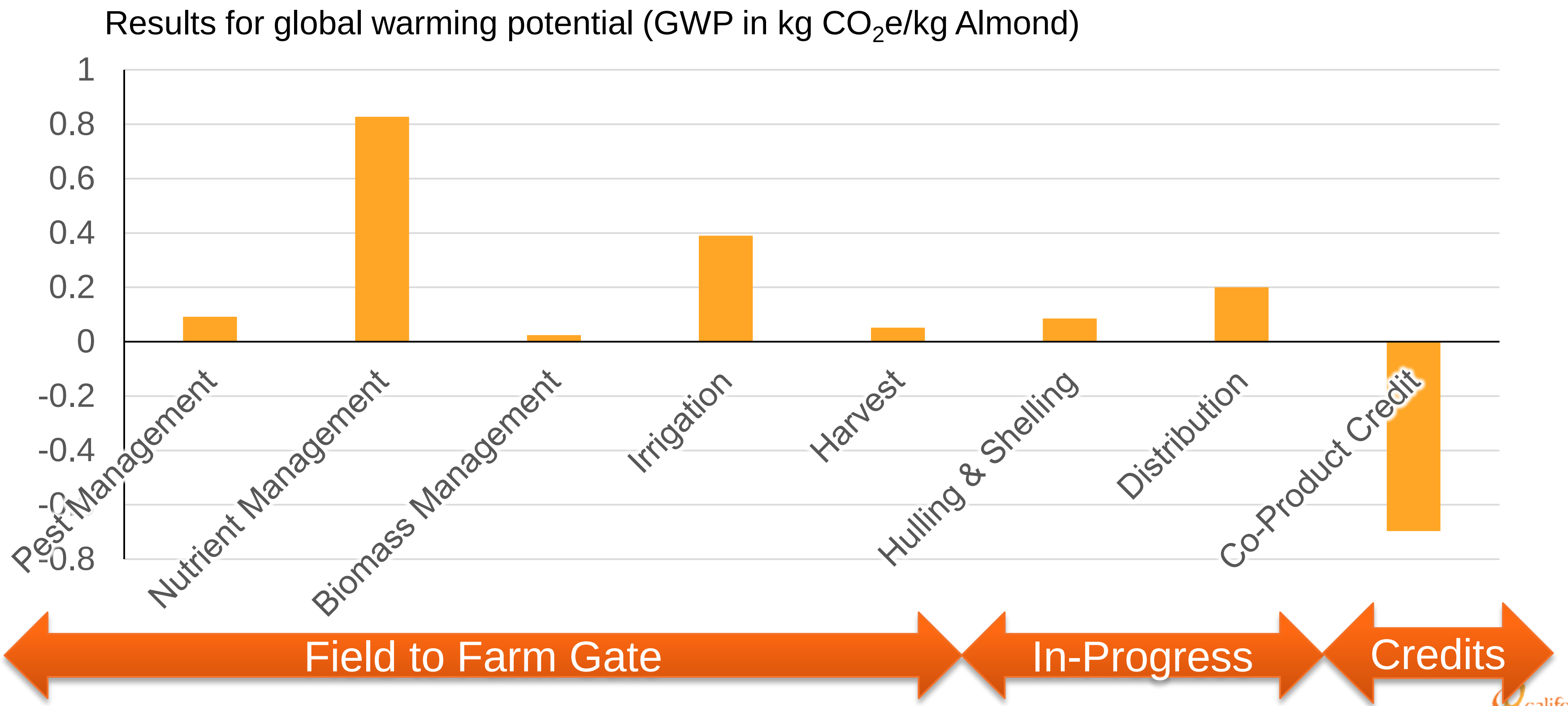


Preliminary results for Distribution: Quantity or exports, weighted distance of travel, and CO_2e of Almond Distribution by Region

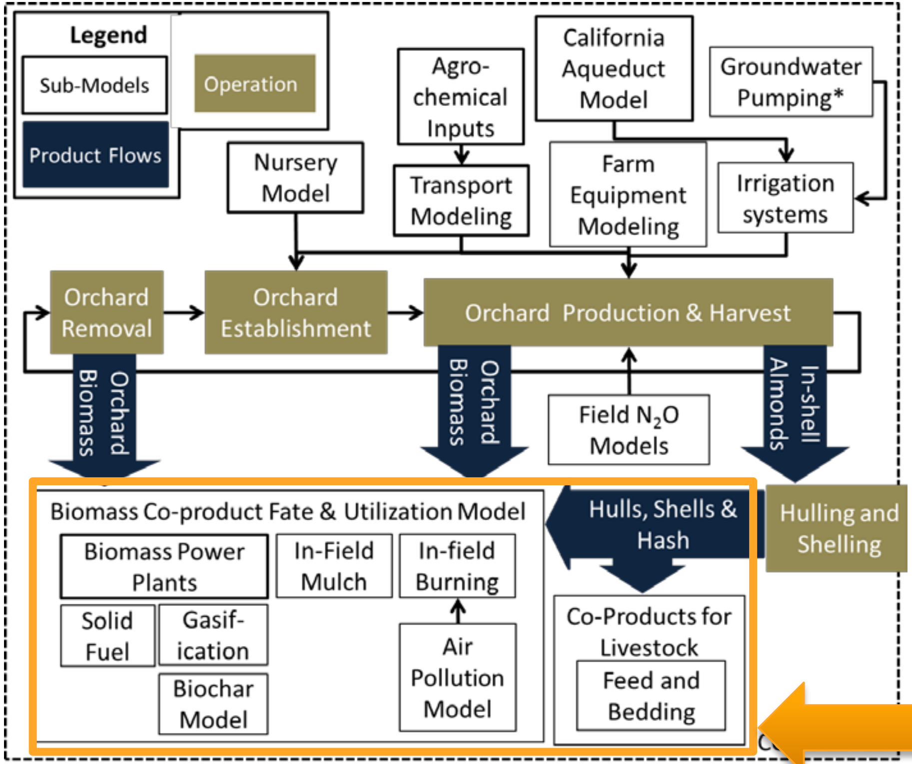


These are very preliminary results, but they suggest that distribution could add, on average 0.2 kg CO2e per kg of almond exported.

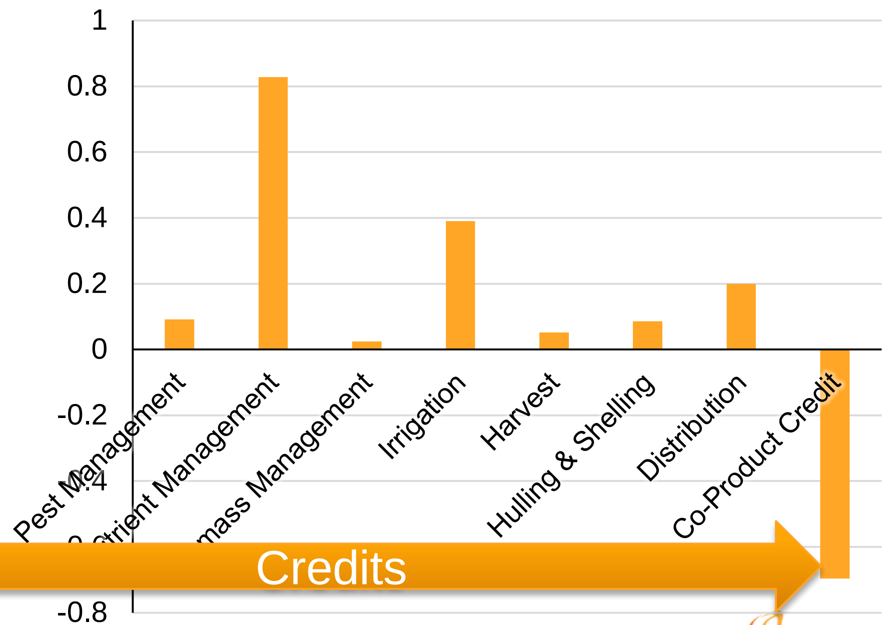
Results of Completed Scope + Distribution



Importance of Co-Product Credits for Environmental Performance



- Results for global warming potential (GWP) and total life cycle energy per kg of almond



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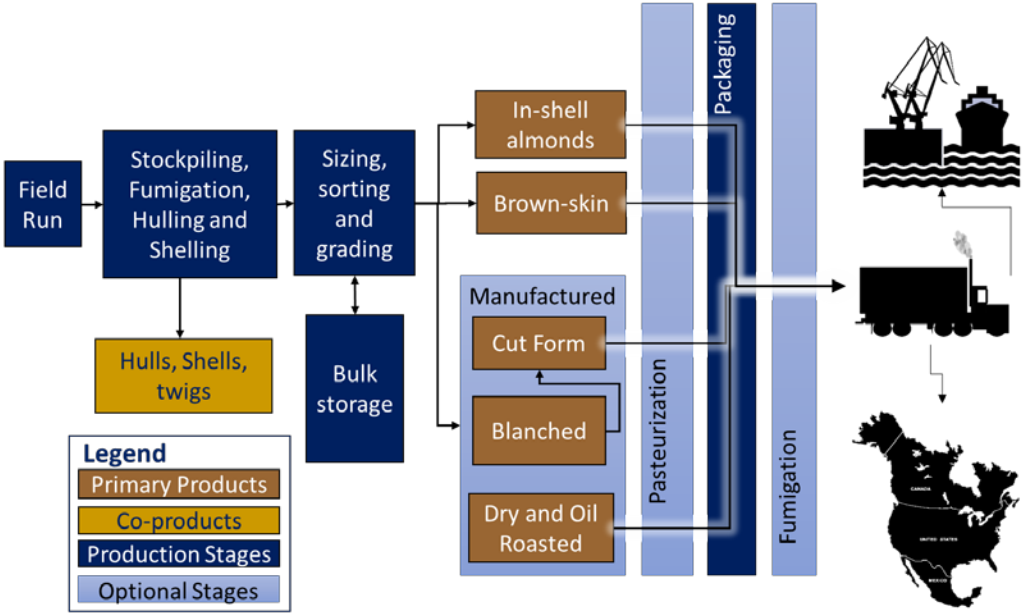
Processing and Distribution Next-Steps

- Processing
  - Data collection is on-going
  - Priority is to continue to build relationships with processors to collect data.
  - These requests are set up with confidentiality agreements
- Distribution
  - Distribution modeling will be refined and validated
- My contact information: amkendall@ucdavis.edu



Bruce Lampinen,
University of California, Davis

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Regional Almond Variety Trials for Cultivar Evaluation in California

Bruce Lampinen[1], G. Brar[2], J.H. Connell[3], R.A. Duncan[4]
S.G. Metcalf[1], Bill Stewart[1], M.A. Thorpe[1], T. M. Gradziel[1],
Mario Viveros[5] and Minerva Gonzales[5]

[1]UC Davis Plant Sciences [2]UCCE Fresno/Madera Counties [3]UCCE Butte County
[4]UCCE Stanislaus County [5]UCCE Kern County

I will talk about one ongoing trial and 3 new trials

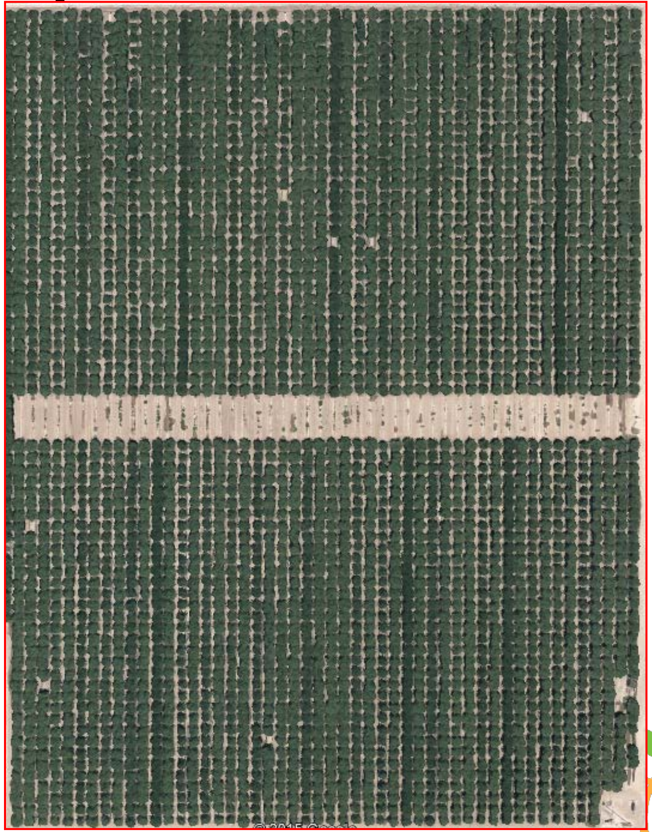
- McFarland Replicated Variety Trial
  - Grower orchard trial in Kern County

- Three new regional almond variety trials planted in 2014
  - Butte County- Chico State University Farm
  - Stanislaus County- school district site near Salida
  - Madera County- a grower site near Chowchilla

McFarland replicated variety trial planted in 2004

- Grower site near McFarland in Kern County
- Class 1 McFarland loam/Wasco Sandy loam
- 18’ x 20’ spacing (121 trees/acre)
- Irrigated with double line drip
- Replicated six times (approximately 35 trees/rep)

7 pollenizers	8 Nonpareil Clones
Chips	Nonpareil- 38270
Kahl	Nonpareil- 5
Kester (2-19e)	Nonpareil- 6
Kochi	Nonpareil- 7
Marcona	Nonpareil- Driver
Sweetheart	Nonpareil- Jones
Winters	Nonpareil-Newell
	Nonpareil- Nico



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McFarland replicated variety trial

- Early yields are directly related to trees per acre

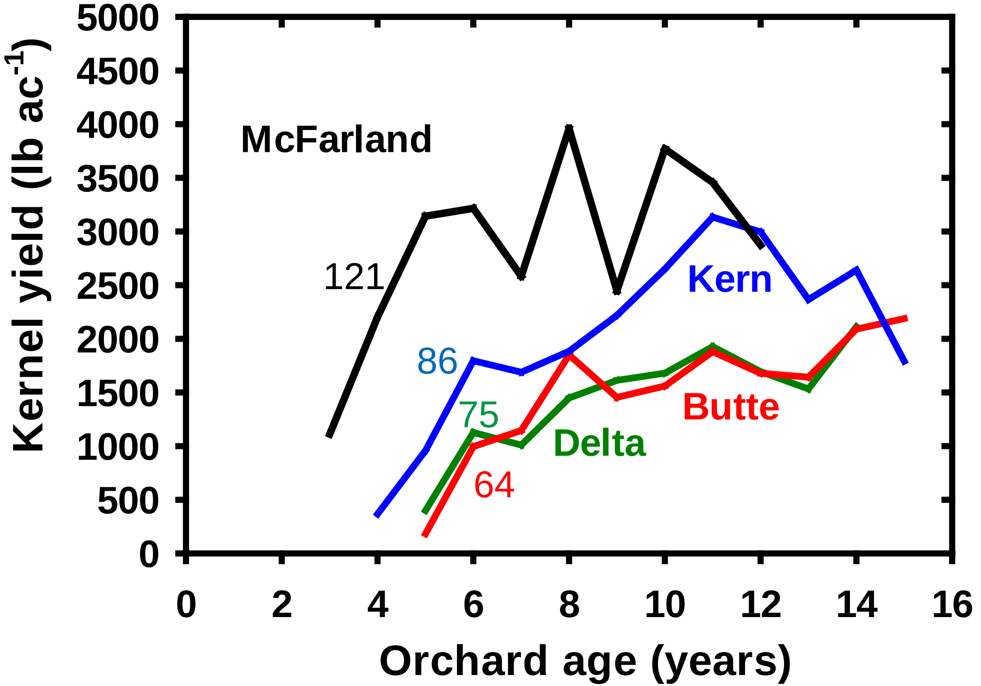

Fig. 1. Average annual yield for all varieties and selections combined at each trial by orchard age.

McFarland replicated variety trial

- Early yields are directly related to trees per acre

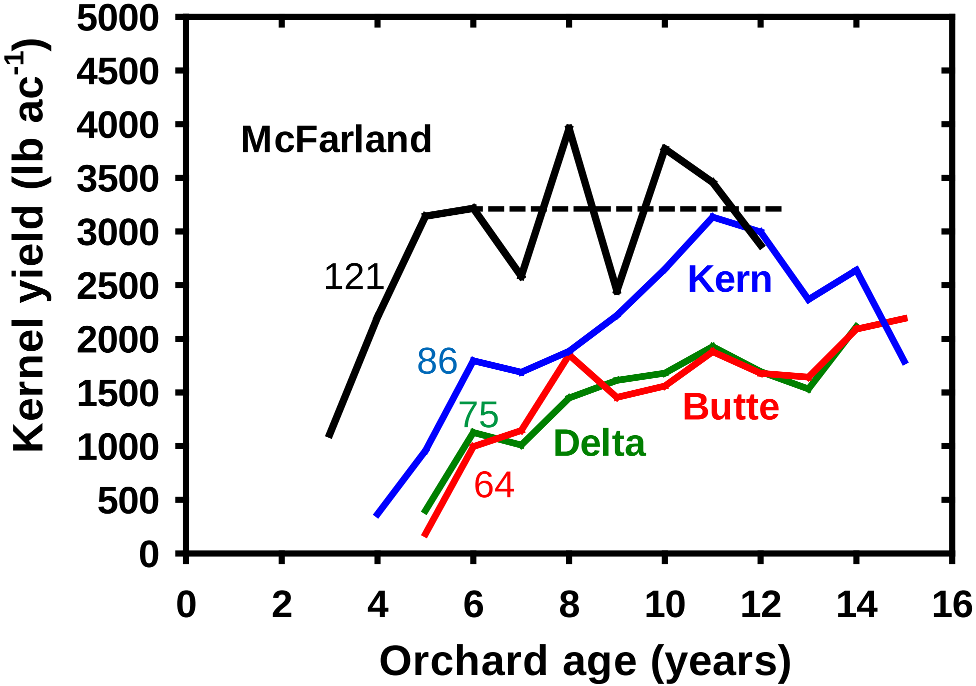

Fig. 1. Average annual yield for all varieties and selections combined at each trial by orchard age.

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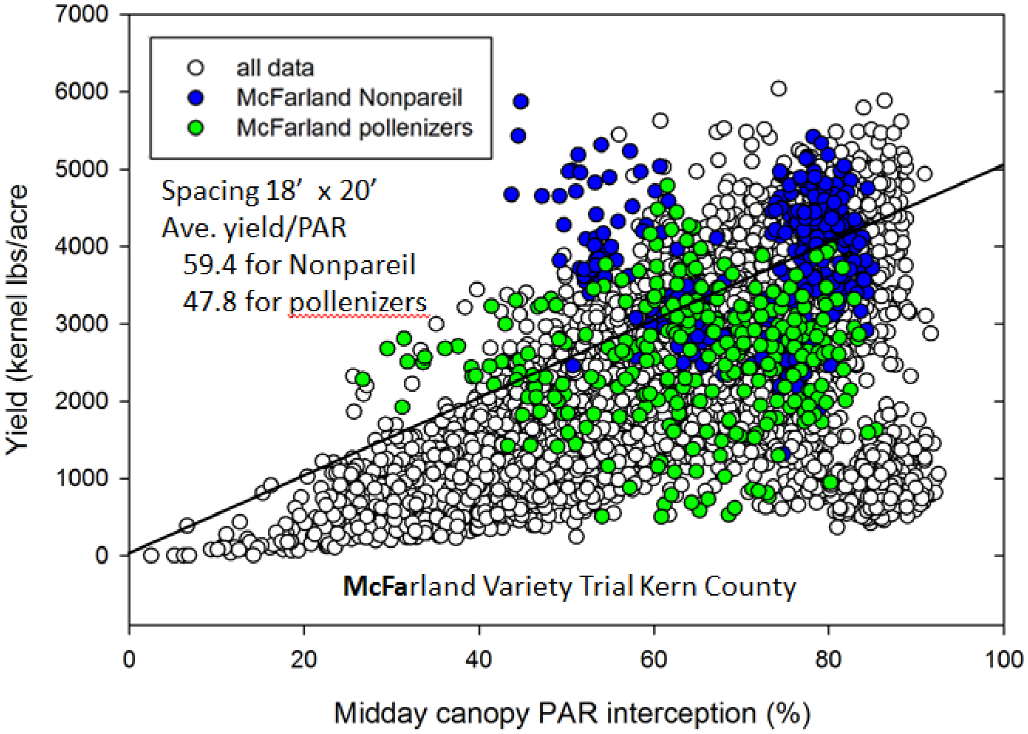
McFarland replicated variety trial

- This is the highest yielding almond site in our light bar study
  - Nonpareil- 59.4 kernel pounds per 1% PAR intercepted
  - Pollenizers- 47.8 kernel pounds per 1% PAR intercepted



McFarland replicated variety trial- ranked by cumulative yield to 12 years

2015 Variety	No. of nuts/tree	Average kernel wt (g)	Shelling percentage	Kernel pounds per unit PAR int.	Kernel pounds per Tree	Kernel pounds per Acre	Cumulative kernel yield (lbs/acre)
Nonpareil-Nico	12982 abc	1.07 bc	68.6 ab	46.5 ab	30.8 ab	3728 ab	35046 a
Nonpareil-3-8-2-70	11502 de	1.10 b	71.3 a	41.8 bcd	27.9 bc	3383 bc	33870 ab
Nonpareil-Newell	12638 bcd	1.10 b	72.8 a	44.2 abcd	30.5 ab	3702 ab	33784 ab
Nonpareil-Driver	12664 bcd	1.07 bc	72.8 a	45.1 abc	29.9 ab	3623 ab	33447 bc
Nonpareil-7	14058 a	1.01 cd	73.9 a	46.1 ab	31.3 a	3797 a	33222 bcd
Nonpareil-5	11025 e	1.11 b	72.6 a	40.7 cde	26.9 c	3263 c	32560 bcd
Nonpareil-Jones	13579 ab	1.00 d	69.5 ab	45.1 abc	30.2 ab	3659 ab	32286 cd
Nonpareil-6	11439 de	1.06 bcd	71.0 a	40.0 cde	26.8 c	3246 c	32077 d
2-19e	7827 g	0.94 e	52.5 e	25.0 g	16.2 e	1965 e	29086 e
Winters	5464	1.06 bcd	62.1 cd	22.6 g[illegible]	12.7 f	1542 f	26075 f
Chips	11843 cde	0.89 ef	57.4 d	37.2 ef	23.1 d	2806 d	25159 f
Kahl	13661 ab	0.84 f	58.4 d	47.9 a	25.4 cd	3081 cd	25127 f
Sweetheart	6953 g	0.86 f	64.9 bc	20.0 [illegible]	13.2 f	1607 f	23402 g
Kochi	9506 f	1.08 b	65.3 bc	35.8 f	22.7 d	2758 d	20404 h
Marcona	2798	1.27 a	26.2 [illegible]	13.2	7.7 g	943 [illegible]	17548 i

- Some separation among Nonpareil clones in terms of cumulative yield
- 2-19e (Kester) and Winters top yielding among pollenizers

McFarland replicated variety trial- tree circumference and height

	2007		2015	
Variety	**Circ (cm)**	**Height (meters)**	**Circ (cm)**	**Height (meters)**
Marcona	42.8 bc	4.75 gh	75.4 bc	7.66 a
Nonpareil 7	43.4 ab	5.27 a	74.9 bc	7.38 b
Nonpareil 6	42.5 bc	5.14 abc	75.7 bc	7.34 b
Nonpareil 38270	43.1 bc	5.01 cdef	75.8 bc	7.20 bc
Kochi	44.5 a	4.65 hi	82.6 ab	7.07 cd
Sweetheart	43.7 ab	5.12 abcd	77.5 bc	7.04 cd
Nonpareil Nico	42.4 bc	5.22 ab	74.6 bc	7.01 cd
Nonpareil 5	42.5 bc	5.04 bcde	74.7 bc	7.00 cd
Nonpareil Newell	42.5 bc	4.85 fg	88.2 a	6.91 de
Nonpareil Dr	41.9 cd	4.99 cdef	73.9 bcd	6.74 e
Nonpareil J	40.0 e	4.84 fg	73.3 bcd	6.69 e
Kahl	41.0 de	5.16 abc	63.1 d	6.69 e
Chips	40.4 e	4.40 j	67.5 cd	6.43 f
2-19e (Kester)	42.1 cd	4.93 ef	67.7 cd	6.37 f
Winters	42.1 cd	4.58 i	69.1 cd	6.09 g

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Next Generation Regional Almond Variety Trials
Planted in 2014

Site	Rootstock	Spacing	Trees/acre
Butte	Krymsk 86	18’ x 22’	110
Stanislaus	Nemaguard	16’ x 21’	130
Madera	Hansen 536	12’ x 21’	173

Next Generation Regional Almond Variety Trials Planted in 2014

Site	Rootstock	Spacing	Trees/acre
Butte	Krymsk 86	18’ x 22’	110
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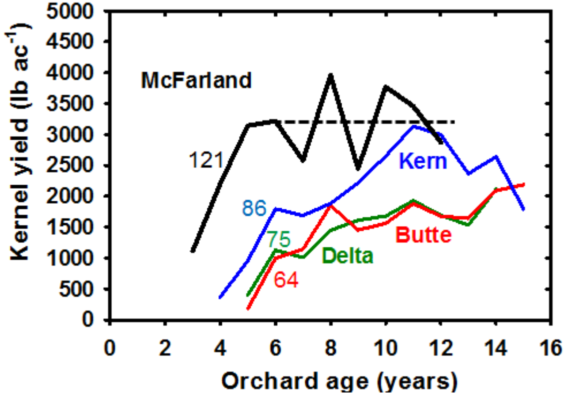

2014 Regional Almond Variety Trials- large replicated trials

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2014 Regional Almond Variety Trials

	Variety	Source
1	Eddie	Bright's
2	Capitola	Burchell
3	Supareil	Burchell
4	self-fruitful P16.013	Burchell
5	Self-fruitful P13.019	Burchell
6	Booth	Burchell
7	Sterling	Burchell
8	Bennett	Duarte
9	Nonpareil	Fowler
10	Durango	Fowler
11	Jenette	Fowler
12	Aldrich	Fowler
13	Marcona	Spain
14	Winters	UCD
15	Sweetheart	UCD
16	Kester (2-19e)*	UCD
17	UCD3-40	UCD

	Variety	Source
18	UCD18-20	UCD
19	UCD1-16	UCD
20	UCD8-160	UCD
21	UCD8-27	UCD
22	UCD1-271	UCD
23	UCD1-232	UCD
24	UCD7-159	UCD
25	UCD8-201	UCD
26	Y121-42-99	USDA
27	Y117-86-03	USDA
28	Y116-161-99**	USDA
29	Y117-91-03	USDA
30	Folsom	Wilson
31	Wood Colony on Krymsk 86 (Butte only)	
31	Lone Star on Hansen 536 (Chowchilla only	

Bloom, hullsplit, yield and quality data will be collected at these sites in 2016

Questions?

Acknowledgements- Thanks to the Almond Board of California, The Billings Ranch, Chico State University, Salida School District and the Creekside Farming Company for supporting this work

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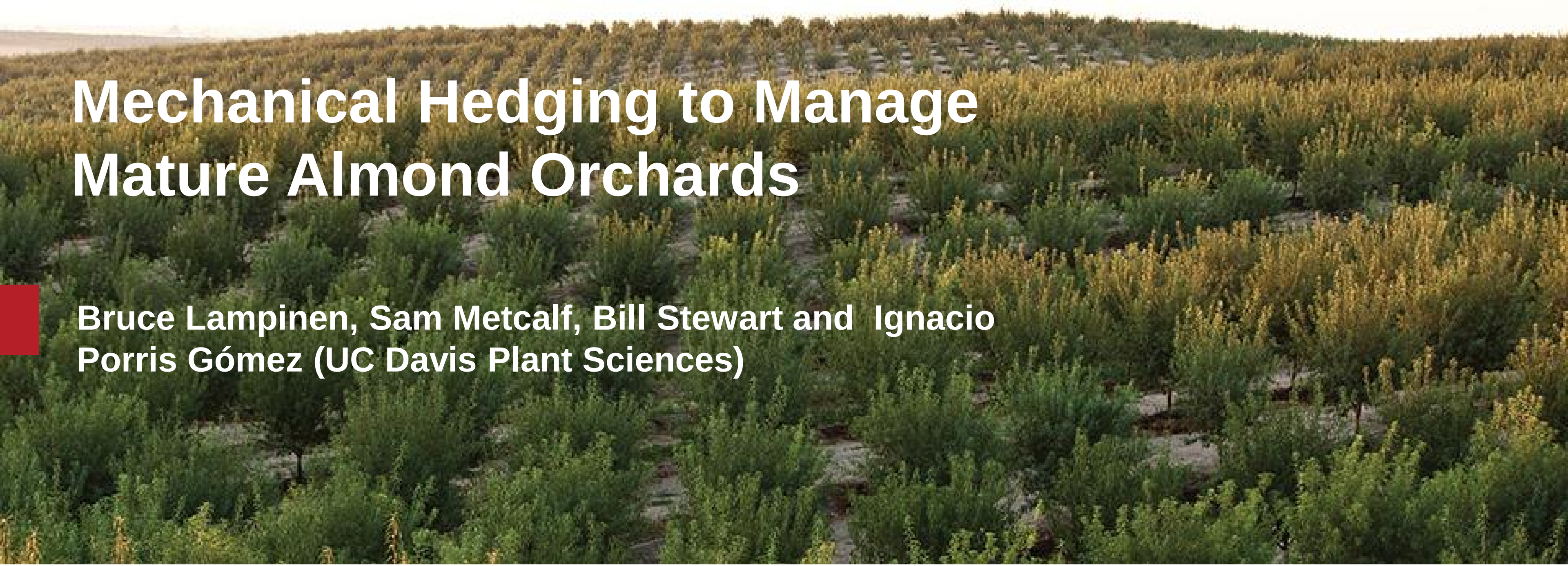

Mechanical Hedging to Manage Mature Almond Orchards

Bruce Lampinen, Sam Metcalf, Bill Stewart and Ignacio Porris Gómez (UC Davis Plant Sciences)

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Mechanical hedging trial Kern County

Site- Kern County orchard planted in 2000

- 50 Monterey
- 25% Nonpareil
- 25% Wood Colony

Tree spacing- 21’ x 24’

Orchard hedged once about 3 years previous to trial initiation

Hedging treatments imposed in December 2013

- Unhedged control
- 28” hedging cut
- 38” hedging cut
- 48” hedging cut

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Large replicated trial with 12 replications covering 75 acres

⇧ N

Rep#	1	2	3	4	5	6	7	8	9	10	11	12
	28”	28”	48”	0’	38”	48”	38”	48”	38”	38”	48”	0’
	0’	38”	38”	28”	48”	0’	28”	28”	0’	48”	38”	28”
	48”	0	0	48”	0	38”	0’	38”	48”	28”	28”	38”
	38”	48”	28”	38”	28”	28”	48”	0’	28”	0’	0’	48”
Row# (from east)	51	47	43	39	35	31	27	23	19	15	11	7

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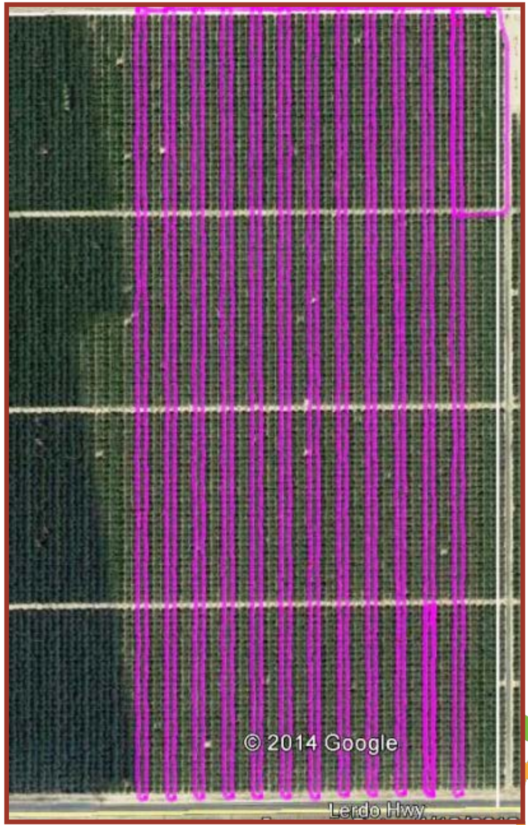
Mobile platform lightbar used to follow canopy regrowth



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Photos of hedged plots on June 22, 2014

Unhedged

28”

38”

48”

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Photos on day of hedging on Dec. 12, 2013

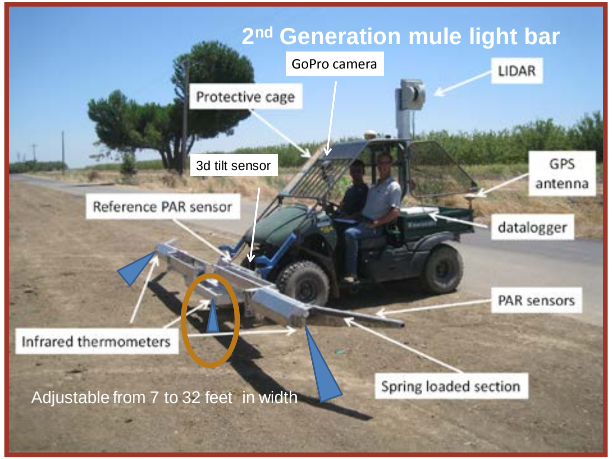
28”

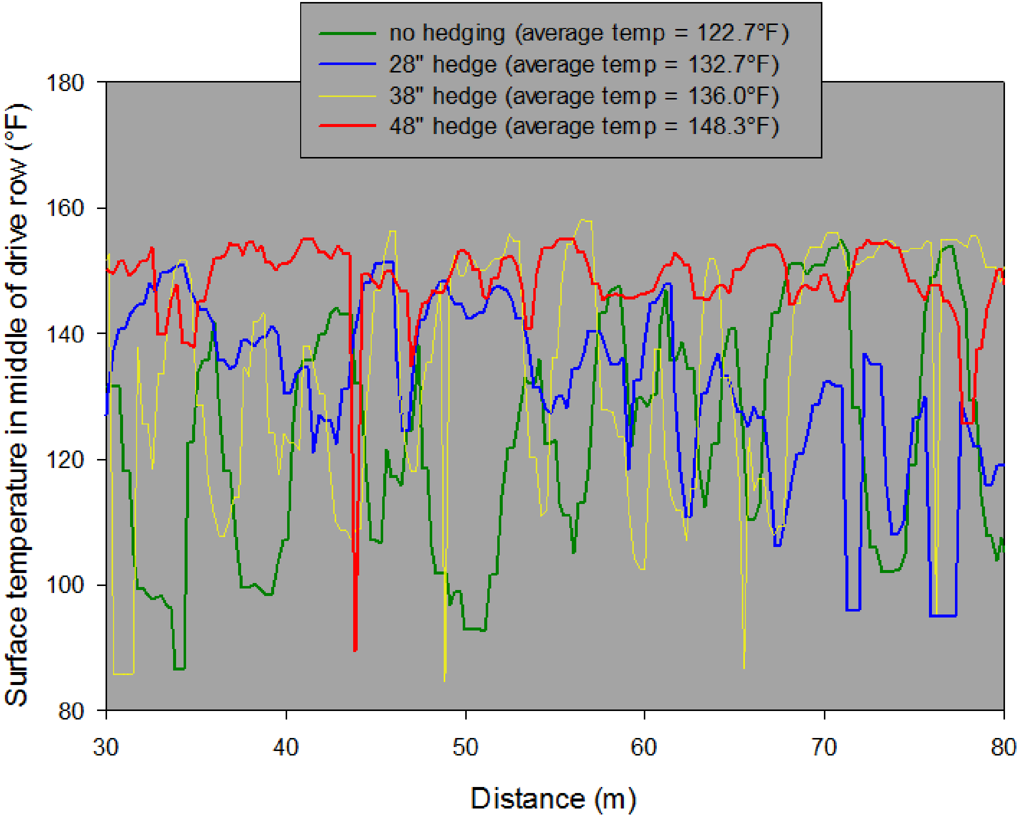
38”

48”

Representative branches from hedging treatments

Midday soil surface temperature July 2015





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Hedging trial PAR, yield and yield per unit PAR intercepted summary

No significant treatment differences before imposition of hedging

Nonpareil

Year	Hedging Treatment	PAR interception (%)	Yield (kernel lb/ac)	Yield per unit PAR intercepted
2013	Unhedged	78.8 a	3226 a	40.9 a
	28 inches	78.9 a	3178 a	40.3 a
	38 inches	78.1 a	3351 a	42.9 a
	48 inches	77.5 a	3192 a	41.2 a
2014	Unhedged	76.5 a	2414 a	31.6 a
	28 inches	74.4 b	2274 a	30.7 a
	38 inches	73.2 bc	2287 a	31.3 a
	48 inches	72.2 c	2337 a	32.4 a
2015	Unhedged	78.0 a	2735 a	35.0 b
	28 inches	76.6 ab	2662 a	34.7 b
	38 inches	75.5 b	2789 a	36.9 ab
	48 inches	74.5 b	2874 a	38.6 a
2014 + 2015 sum	Unhedged	77.8 a	5149 a	35.8 a
	28 inches	76.8 ab	4936 a	35.3 a
	38 inches	75.7 b	5076 a	37.0 a
	48 inches	75.0 b	5211 a	37.3 a

Monterey

Year	Hedging Treatment	PAR interception (%)	Yield (kernel lb/ac)	Yield per unit PAR intercepted
2014	Unhedged	72.7 a	2277 b	31.3 b
	28 inches	71.0 ab	2457 ab	34.7 a
	38 inches	71.2 ab	2408 ab	33.8 ab
	48 inches	70.5 b	2526 a	35.8 a
2015	Unhedged	70.9 a	2388 a	33.7 a
	28 inches	69.3 b	2349 a	33.8 a
	38 inches	69.1 b	2372 a	34.2 a
	48 inches	67.9 b	2443 a	35.9 a
2014 + 2015 sum	Unhedged	70.1 a	4665 a	33.3 b
	28 inches	68.6 ab	4806 a	35.1 ab
	38 inches	68.5 ab	4780 a	34.8 ab
	48 inches	67.4 b	4969 a	36.8 a

Monterey on left and Nonpareil on right

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Cumulative yield for 2014 plus 2015

Monterey and Nonpareil combined average

2014 + 2015 sum

Hedging Treatment	PAR interception (%)	Yield (kernel lb/ac)	Yield per unit PAR intercepted
Unhedged	74.4 a	4907 a	34.8 b
28 inches	73.1 ab	4806 a	35.2 ab
38 inches	72.6 b	4928 a	36.1 ab
48 inches	71.7 b	5090 a	37.1 a

Conclusions

Under the conditions of this trial (at a spacing of 21’ x 24’)

- Hedging at widths up to 48” did not cause negative impact on yield for the cumulative results for two years after hedging
- Hedging let more light to the orchard floor which should decrease food safety risk and increase drying efficiency

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Questions?

Malli Aradhya,
USDA-ARS, Davis, CA

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Integrated Conventional and Genomic Approaches to Almond Rootstock Development

Malli Aradhya/Craig Ledbetter/Dan Kluepfel
USDA-ARS

Three-Pronged Approach to Rootstock Development

1. Produce and evaluate diverse interspecific hybrids for tolerance to soil borne diseases (CG, PHY, NEM)
2. Develop and identify single nucleotide markers (SNPs) linked to diseases resistance among hybrids
3. Develop effective marker selection strategies to rapidly develop improved rootstocks (MAS)

Prerequisites for Rootstock Breeding

USDA-ARS

I. Plant

- Well characterized germplasm (wild species) - NCGR
- Sources of resistance
- Production of diverse hybrids in sufficient numbers – Number Game
- Good embryo rescue and clonal propagation systems

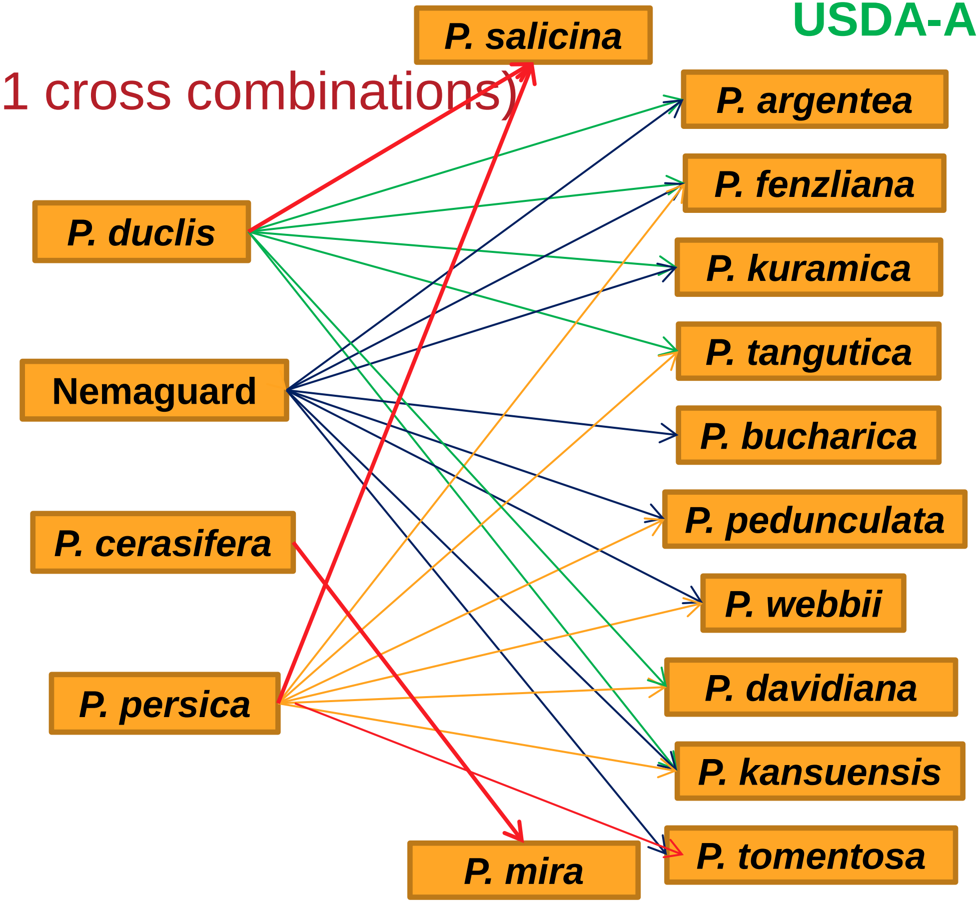
II. Molecular Markers

- Good markers (SNPs – GBS) to develop marker-assisted breeding tools
- Reliable diseases testing schemes
- Identification and validation of markers and haplotypes

Production of Interspecific Hybrids

Almond Board of California

Diversity of Hybrids Produced (61 cross combinations)



A total of >5700 clonal plants were produced for disease evaluation

Stages in the Production of Hybrids

- Crosses/Hand pollination
- Harvesting immature Fruits
- Embryo culture on artificial TC media
- Embryogenic Callous
- Shoot Multiplication
- Rooting
- Greenhouse Plants

Clonal hybrid plants

USDA-ARS

Disease Testing of Hybrids

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Phytophthora Testing of Rootstock Hybrids

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CG Evaluation of Rootstock Hybrids

Left to Right - Genotype P-2-11 is susceptible, whereas genotypes P-2-4, P-4-25, and P-4-10 show resistance

USDA-ARS

Disease Testing of Rootstock Hybrids

Phytophthora Evaluation (L-R) Marianna 2624, P-4-1, and P-2-4, three suceptible interspecific hybrids, L-1-2, and ‘Nemaguard’.

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Marker Development

Association Analysis

USDA-ARS

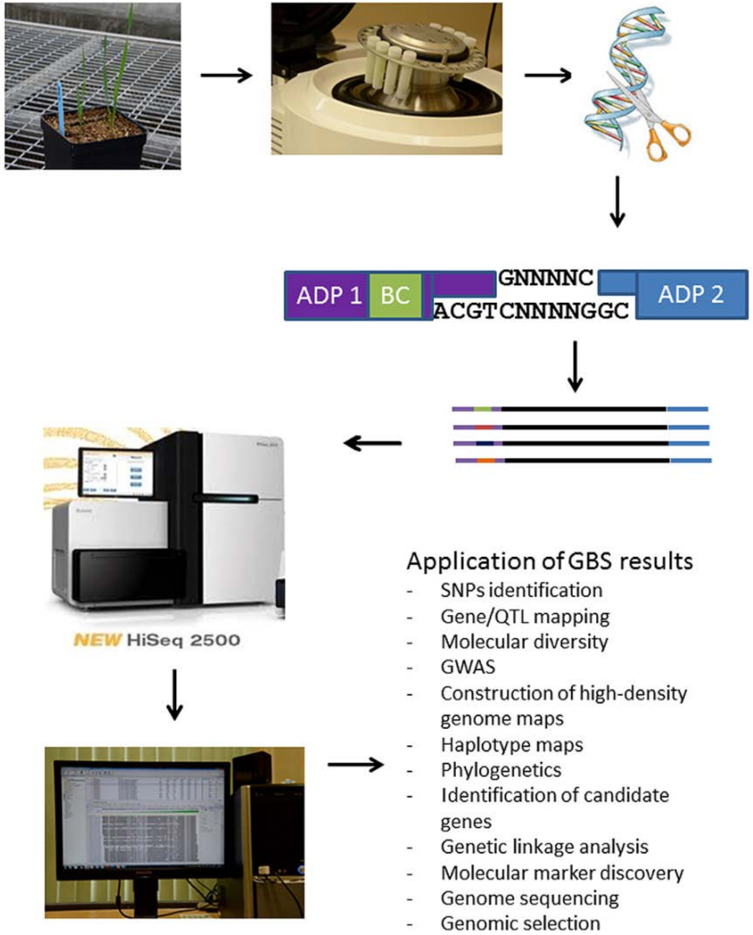
GBS Technology for SNP Genotyping

SNP Development

190 Commercial
UC Trails/FPS/
Novel Rootstocks

Disease Data

ABC Annual Reports
And personnal coomunication
From Plant Pathologists



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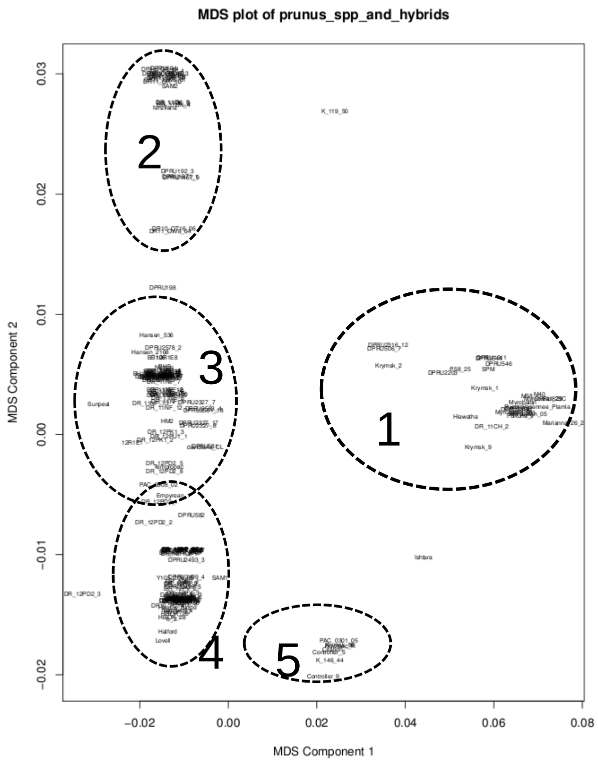
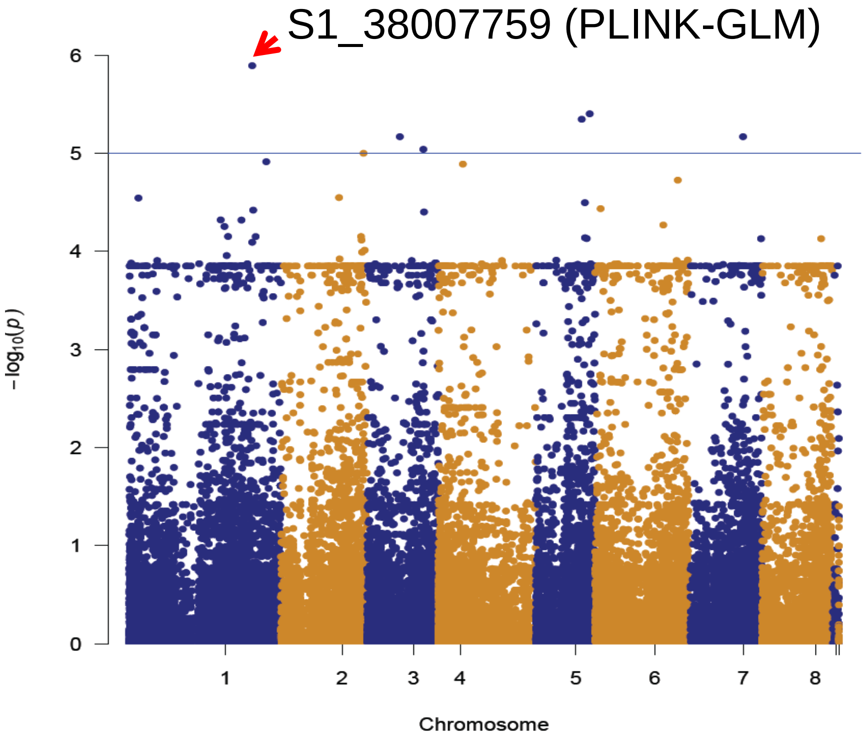
Marker linked to CG resistance

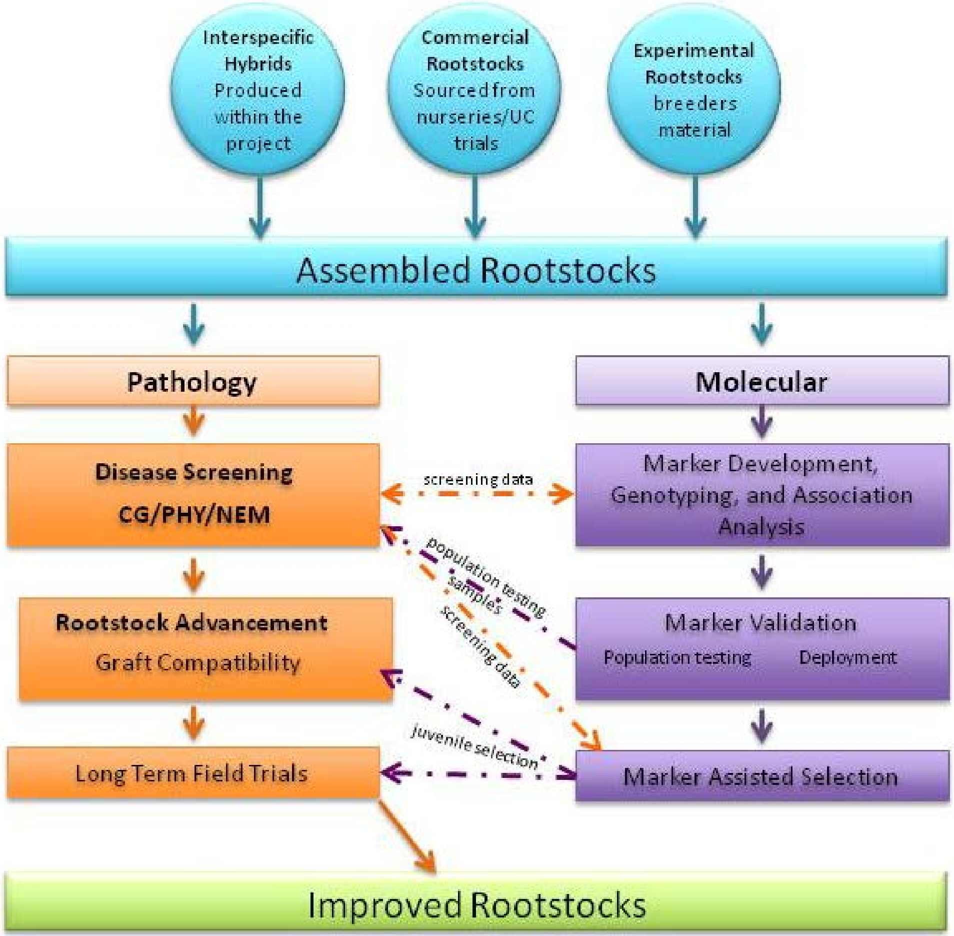




Results of mixed linear model analysis from TASSEL indicating several SNPs significantly associated with CG (p<0.05).

Marker	Chr	Site	df	F	p	Error df	Marker R^2
S1_212063151	8	15627172	2	5.94159	0.00831	36	0.11168
S1_72042880	2	25165154	2	6.29985	0.00843	31	0.10136
S1_54210819	2	7333093	1	10.30516	0.00513	29	0.09392
S1_136457227	*5*	*10217200*	*2*	*6.0658*	*0.00969*	*31*	*0.09334*
S1_136457228	*5*	*10217201*	*2*	*6.0658*	*0.00969*	*31*	*0.09334*
S1_136457231	*5*	*10217204*	*2*	*6.0658*	*0.00969*	*31*	*0.09334*
S1_7294016	1	7294016	2	5.72594	0.00959	36	0.0907

In Summary


Interspecific Hybrids Produced within the project
Commercial Rootstocks Sourced from nurseries/UC trials
Experimental Rootstocks breeders material
Assembled Rootstocks
Pathology
Molecular
Disease Screening
CG/PHY/NEM
screening data
Marker Development, Genotyping, and Association Analysis
population testing
samples
screening data
Rootstock Advancement
Graft Compatibility
Marker Validation
Population testing
Deployment
juvenile selection
Long Term Field Trials
Marker Assisted Selection
Improved Rootstocks

Cooperators

Greg Brown	Research Plant Pathologist, USDA-ARS
Andreas Westphal	Nematologist, UCR, KAC
John Preece	Research Leader, NCGR, USDA-ARS
Carolyne DeBuse	Prunus Horticulturist, USDA-ARS
Tom Gradziel	Professor, Plant Sciences, UCD

Katherine Pope,
UCCE – Yolo, Solano, Sacramento Counties

growing ADVANTAGE
The Almond Conference

Young Orchard Management Educational Materials

Kat Pope, Orchard Advisor,
Sacramento, Solano & Yolo Counties

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YOUNG ORCHARD HANDBOOK

INTRODUCTION

This publication provides an overview of recent research and information to assistant in the management of young almond and walnut orchards. Proper management of an orchard in the first five years of its life will help optimize orchard health, growth and yield over the life of the orchard. This text is by no means exhaustive, and is meant as an introductory resource for understanding management steps to take in young orchards. Additional resources to consult for more detailed information are provided at the end of each chapter.

CONTENTS

KATHERINE POPE, UC Cooperative Extension Farm Advisor, Sacramento, Solano & Yolo Counties;

ALLAN FULTON, UC Cooperative Extension Farm Advisor, Tehama County;

DAVID DOLL, UC Cooperative Extension Farm Advisor, Merced County;

BRUCE LAMPINEN, UC Cooperative Extension Almond & Walnut Specialist;

and BRAD HANSON, UC Cooperative Extension Weed Specialist

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Irrigating Young Orchards

Katherine Pope & Allan Fulton

Proper irrigation management for young orchards is critical for managing tree growth in the early (non-bearing) years of the orchard's life. Under-irrigating or over-irrigating can affect tree health and vigor, orchard uniformity, years to full production potential and the total costs to develop an orchard. When the tree and its root system are small, there is a greater chance of applying water and fertilizers outside of the root zone, an inefficient use of water, fertilizer and the energy to move them. Too much water can lead to added pruning and weed control.

Proper irrigation management may be one of the most complicated, dynamic aspects of young orchard management. As trees grow, their canopy size and water needs change, not just from year to year, but also within a season. Plus, as trees grow, so do their root systems, meaning they can capture water from a larger volume of soil.

Figure 1. Drip emitters irrigating outside of the root zone (left) and over the root zone (right).

Knowing how much to irrigate and when requires knowing how much water an irrigation system applies, how much water soils can hold, and how much water trees are using, then refilling that storage when it is used. This requires six steps.

1) Know the water application rate of your irrigation system
2) Figure out how much water your soil can store
3) Note how much water the orchard is using
4) Calculate the maximum allowable time between irrigation
5) Estimate how long the irrigation system will take to refill tree water use
6) Confirm irrigation schedule is on track with soil moisture or crop water stress measurements

We call this series of steps "Irrigation Scheduling".

Step 1) Know the Water Application Rate of Your Irrigation System

Because of the variety of irrigation systems and designs, it is important to know the water application rate of each irrigation system. Usually, the water application rate is specified on system design blueprints when the system is installed. Drip systems generally range from 0.01 to 0.05 inch per hour, partial coverage microsprinklers 0.03 to 0.08 inches per hour and full coverage rotator minisprinklers or impact sprinklers 0.04 to over 0.10 inches per hour.

If you don't have the output from the system installer, you can calculate the average water application rate by knowing how many trees are planted per acre, how many emitters irrigate each tree, and how many gallons each drip or micro-sprinkler emitter puts out per hour when the system is at its recommended pressure.

WORKSHEET EXAMPLE
APPLICATIONS OF IRRIGATION SCHEDULING STEPS AND EQUATIONS

Step 1) Know the Water Application Rate of Your Irrigation System

You'll Need:
- *Number of* drip or microspinkler emitters per tree
- *Trees per acre*
- *Gallons per hour for each emitter*
- *Gallons per acre-inch of water (27,154 gal/ac-in)*

Equation: Emitters per tree x Trees per ac x Gal per hr ÷ Gal per ac-in = Inches applied per hour

Example: Orchard Design and Irrigation System Information
- One minisprinkler per tree
- 120 trees per acre
- 8 gph flow rate at recommended operating pressure

Calculations:

$$\frac{1}{emitter\ per\ tree} \times \frac{120}{trees\ per\ acre} \times \frac{8}{\frac{gal}{hr}/emitter} \times 27{,}154\ gal\ per\ acre-inch$$

$$= 0.035\ \frac{acre-inches}{hour}$$

Step 2) Figure Out How Much Water Your Soil Can Store

You'll Need:
- *Inches of water storage per foot of soil – Based on soil type and 50% ASM from Table 1*
- *Root depth-* 1st leaf≈<1 to 3', 2nd leaf≈2 to 4', 3rd leaf≈3 to 5'

Equation: Inches/foot water storage x feet of root zone = inches stored water to use before tree stress

Example - March planted bare root almond trees, June 1, sandy loam

$$\frac{0.7}{inches\ water\ per\ foot\ of\ soil} \times \frac{1}{feet\ of\ root\ depth} = \frac{0.7}{inches\ water\ to\ tree\ stress}$$

Example - 3rd leaf, vigorous growing almond trees irrigated July 1, sandy loam

$$\frac{0.7}{inches\ water\ per\ foot\ of\ soil} \times \frac{4}{feet\ of\ root\ depth} = \frac{2.8}{inches\ water\ to\ tree\ stress}$$

Fertilizing Young Almond and Walnut Orchards

Katherine Pope and David Doll

Why Fertilize Young Trees

Trees need nutrients to support the growth of vegetative tissue (trunk, roots, branches, leaves) and reproductive tissue (nuts, hulls, etc.). In the first few years of growth, trees generally are growing more vegetative tissue than reproductive tissue. All trees have a certain potential for growth based on cultivar, rootstock, climate, irrigation, and other growing condition. Nutrient deficiency can mean that the growth potential is not met, leading to smaller, stunted trees with weaker growth.

On the other side of the coin, too much fertilizer can have a negative effect. If grossly over-applied, toxicity could occur and kill tender tissues. More commonly, however, is fertilizer rates that lead to excessive vigor, which is indicated by lanky growth and too much space between buds. This interferes with future canopy branching structure and crop load bearing capacity (Figure 1). In nutrient management, it is essential to provide what is needed by the tree at the right time, without negatively impacting

What Type of Fertilizer to Apply

The three major nutrients for plant growth are nitrogen, phosphorus and potassium. Of these, nitrogen is the primary concern for young trees. This nutrient is critical for leaf growth and development of plant proteins. If too little is available leaves will be smaller in size, off-green in color, and overall growth will be stunted. In excess, leaves will be dark green, and vigor will be high. Potassium and phosphorous are required for woody tissue development. These nutrients rarely have been observed to cause toxicities, and deficiencies are not common in non-bearing trees.

Figure 1. Overloading young trees with nitrogen can result in lanky growth, interfering with future canopy structure and limb strength. Photo: D Doll

Training and Pruning Young Almond and Walnut Trees

Katherine Pope & Bruce Lampinen

INTRODUCTION

The primary goal of both training and pruning is to create and maintain a tree that will produce optimal yields and facilitate cultural practices. In the first years the tree is trained to a structure that will support future crop weight and allow for cultural practices, while minimizing cuts which could decrease early yields.

After tree structure has been established, pruning primarily facilitates cultural practices like spraying and harvesting, and removes dead and diseased wood. In the past, pruning has been viewed as a way to invigorate tree growth. Numerous long-term trials have shown minimally pruned trees (pruned for cultural practices and disease control) yield as well or better than more heavily pruned trees.

When using pruning shears be sure shears are sharp. Never allow pruning shears to touch soil, because this can lead to the spread of soil borne diseases, such as crown gall. To cut, place the hook of the shears on the top of the limb and cut upward, with the blade close to the trunk or branch. When using a chain saw, cut at the branch collar to minimize the wound size and promote healing. In typical California conditions, wound dressings on pruning cuts are not necessary.

HOW PRUNING WORKS

Pruning changes where growth occurs by changing the hormone and resource balance. The response to pruning will depend on whether cuts are made during the dormant or growing season, and whether the cut is a thinning or heading cut. However, all pruning is dwarfing because you are cutting nutrients and carbohydrates out of the tree and removing leaves that could supply carbohydrates for new growth.

Dormant pruning creates vigorous regrowth in the spring from the area where the pruning cut was made. When wood is removed, carbohydrate and nutrient reserves in the trunk and roots are divided among fewer growing points the following spring. The heavier the pruning, the greater the localized regrowth.

Pruning in the summer instead of the dormant season will reduce the amount of regrowth that will occur at the pruning point. Summer pruning removes carbohydrate-producing leaves before they can send carbohydrates and nutrients to reserves.

The two different types of pruning cuts – thinning and heading cuts – produce different growth responses and should be done with different goals in mind. Thinning cuts direct growth in a particular area, and/ or removing dead or diseased wood. Make a thinning cut at the branch collar, at the point of origin from the parent limb (Figure 1).

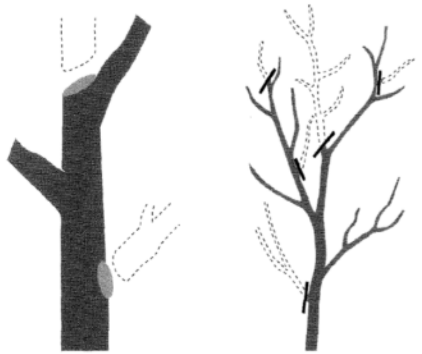

Figure 1. Thinning cuts at the limb's point of origin redirect growth.

Weed Management for Young Orchards

Katherine Pope & Brad Hanson

Weeds in young orchards compete with trees for orchard resources – sunlight, water and nutrients, setting back growth and yield. Weeds can also create cover for vertebrate pests which can then damage tree trunks (Figure 1) and irrigation systems. For these reasons, weed control is important for young orchards.

There are a number of challenges in weed management in young orchards. Young trees often are more susceptible to herbicide damage. A number of different annual grasses and broadleaves need to be controlled. There are fewer herbicides available for use in young orchard, compared with mature trees. Several weed species are beginning to show resistance and/or tolerance towards herbicides that have previously been main-stays of weed management.

Figure 1. Vertebrates can damage young tree in orchards with too many weeds

Figure 2. Weeds can outcompete trees for sunlight, water and nutrients.

There are keys to effective weed control that are true no matter how old your trees. First, the weed problem must be correctly identified. UC Davis's weed identification website is a useful tool for this step: http://weedid.wisc.edu/ca/weedid.php. Next, registered herbicide(s) with activity on your weed spectrum must be selected. Finally, the material must be applied properly, at the appropriate growth stage with well-calibrated equipment.

Precautions with Young Orchard Weed Management

Remember that tree crops are not resistant to herbicides. Crop safety is usually achieved by placement; we avoid injuring trees by placing herbicides below the foliage and green tissues but above the root zone. Knowing this, there are a few important things to keep in mind:

- Green trunk wood is often still susceptible to contact herbicides. Leave cartons on tree trunks for the first two years after planting or until the trunk diameter gets too large.
- Branches on young trees are lower and more likely to get hit by drift. Be extra cautious with windy conditions, spray rig height, nozzle angles, and nozzle selection.
- After planting, tree roots are shallow and soil is still settling, which means soil-applied herbicide can settle or run into loosely packed pockets or cracks. Make sure soil is settled before applying herbicides and manage water carefully to avoid moving herbicides too deeply into the soil.

Flyer with website will be downstairs at the Poster Session

ceyolo.ucanr.edu/Fruit_and_Nuts

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Luke Milliron,
University of California, Davis

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UC-Almond Internship

Luke K. Milliron

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What is the UC-Almond Internship?

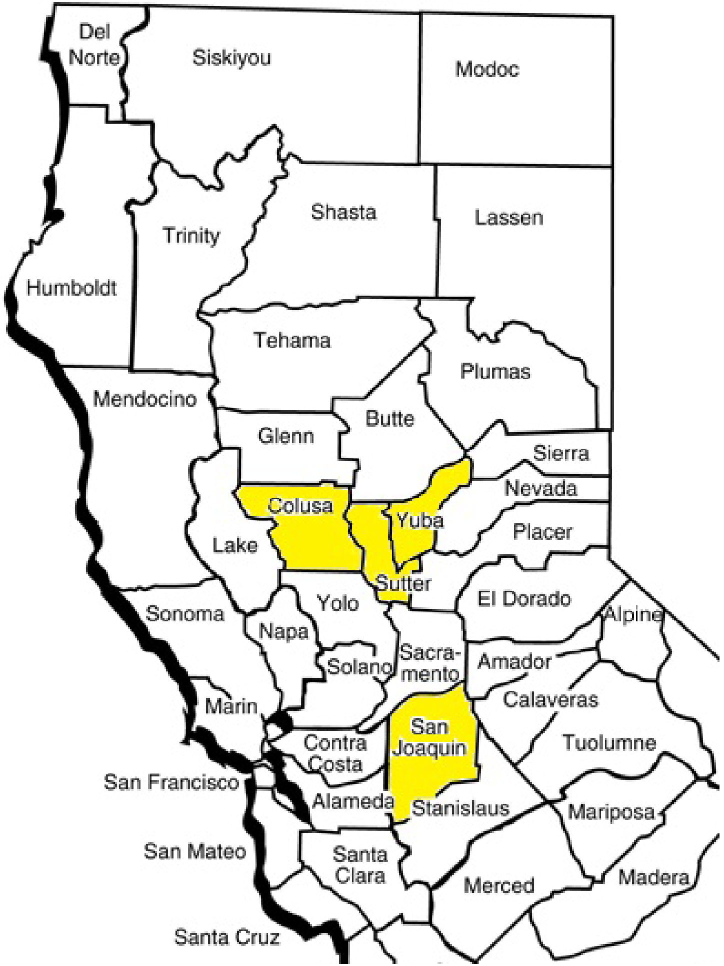
- An internship that helps prepare tree crop Farm Advisor position candidates for a career with the University of California Cooperative Extension (UCCE).
- Interns work with one or more UCCE almond Farm Advisors.
- The Internship follows the complete yearly almond crop lifecycle.

Why is this internship valuable to the California almond industry?

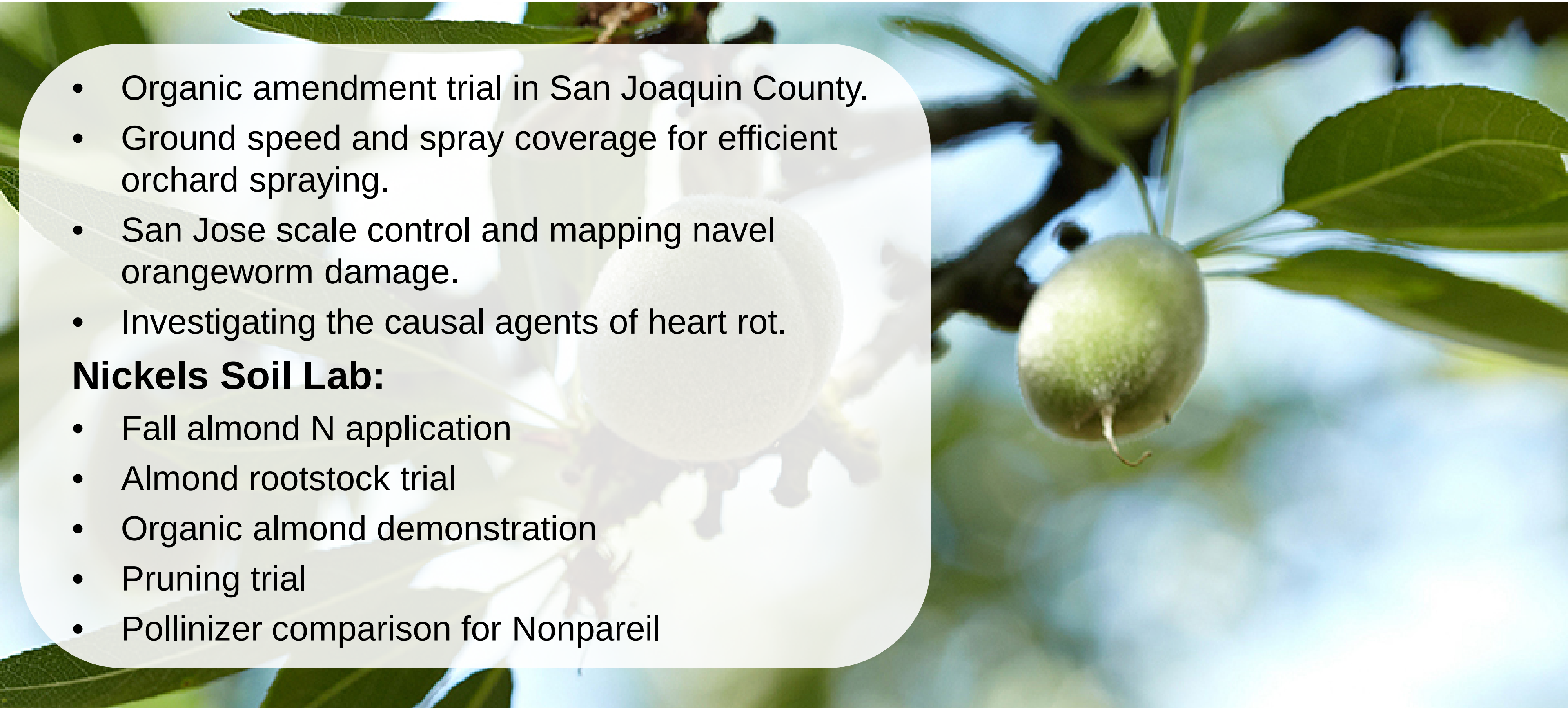
- Takes individuals with the necessary academic qualifications and exposes them to farm advisor responsibilities.
- Transition from being a **specialist** to a **generalist**.
- The intern can quickly provide skilled support to existing almond projects.

My Internship Experience

- January 2015 – March 2016.
- Working with Franz Niederholzer, Brent Holtz and other UC Farm Advisors.
- Serving Sutter, Yuba, Colusa and San Joaquin Counties.



Being a part of applied almond research teams



- Organic amendment trial in San Joaquin County.
- Ground speed and spray coverage for efficient orchard spraying.
- San Jose scale control and mapping navel orangeworm damage.
- Investigating the causal agents of heart rot.

Nickels Soil Lab:

- Fall almond N application
- Almond rootstock trial
- Organic almond demonstration
- Pruning trial
- Pollinizer comparison for Nonpareil

Gaining Experience in Grower Outreach


Thank you Almond Board for investing in an internship that is training future almond researchers!
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