RESEARCH UPDATE: GROWING AND HARVESTING

Room 312-313 | December 6 2017
CEUs – New Process

**Certified Crop Advisor (CCA)**
- Sign in and out of each session you attend.
- Pickup verification sheet at conclusion of each session.
- *Sign in sheets are located at the back of each session room.*

**Pest Control Advisor (PCA), Qualified Applicator (QA), Private Applicator (PA)**
- Pickup scantron at the start of the day at first session you attend; complete form.
- Sign in and out of each session you attend.
- Pickup verification sheet at conclusion of each session.
- Turn in your scantron at the end of the day at the last session you attend.

*Sign in sheets and verification sheets are located at the back of each session room.*
AGENDA

• Bob Curtis, Almond Board of California, moderator
• Franz Niederholzer, UCCE-Colusa Co.
• Mohammad Yaghmour, UCCE-Kern Co.
• Roger Duncan, UCCE-Stanislaus Co.
• Anna Davidson, UC Davis
• Brian Bailey, UC Davis
• Bruce Lampinen, UC Davis
Research at Nickels Soil Lab

F.J.A. Niederholzer
UC ANR CE Farm Advisor,
Colusa/Sutter/Yuba Counties
MAJOR PROJECTS UNDERWAY AT NICKELS & YEAR PLANTED

- Pruning (1997)
- Nonpareil pollinator groups (2006)
- Organic demo (2006)
- Self-fertile vs. high value NP planting (2013)
- Planting density down-the-row (2017)
AVERAGE PRODUCTION IN THE ORGANIC AND CONVENTIONAL DEMONSTRATION BLOCK. 4\textsuperscript{TH} – 12\textsuperscript{TH} LEAF

![Graph showing average production in organic and conventional demonstration block from 2008 to 2018. The graph plots yield (kernel lbs per acre) against years, with data points for each year. The graph includes two lines: one for conventional yield and another for organic yield. The leaf N content for conventional and organic yield are 2.75% and 2.16% respectively.](image-url)
### IMPACT OF POLLINATOR SELECTION ON NP YIELD (KERNEL LBS/ACRE), 12TH LEAF. 2017

<table>
<thead>
<tr>
<th>Variety Group</th>
<th>Rep 1</th>
<th>Rep 2</th>
<th>Rep 3</th>
<th>Ave*</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Fritz/Nonpareil/Monterey</td>
<td>2818</td>
<td>2558</td>
<td>2531</td>
<td>2636</td>
</tr>
<tr>
<td>B. Winters/Nonpareil/Aldrich</td>
<td>2835</td>
<td>2809</td>
<td>2654</td>
<td>2766</td>
</tr>
<tr>
<td>C. Winters/Nonpareil/Monterey</td>
<td>2599</td>
<td>2631</td>
<td>2827</td>
<td>2686</td>
</tr>
</tbody>
</table>

*No significant statistical difference at 5% (Duncan’s HSD)*
# CUMULATIVE YIELD FOR EACH VARIETY AND REP, 3rd TO 12th LEAF, 2017

<table>
<thead>
<tr>
<th>Variety</th>
<th>Rep 1</th>
<th>Rep 2</th>
<th>Rep 3</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aldrich.B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fritz.A</td>
<td>21702</td>
<td>20773</td>
<td>19631</td>
<td>20,702 ab</td>
</tr>
<tr>
<td>Nonpareil.B</td>
<td>21091</td>
<td>21635</td>
<td>21145</td>
<td>21,290 ab</td>
</tr>
<tr>
<td>Winters.B</td>
<td>21227</td>
<td>22024</td>
<td>19337</td>
<td>20,863 ab</td>
</tr>
<tr>
<td>Nonpareil.A</td>
<td>21204</td>
<td>21284</td>
<td>21801</td>
<td>21,430 ab</td>
</tr>
<tr>
<td>Winters.C</td>
<td>22724</td>
<td>20814</td>
<td>20805</td>
<td>21,448 ab</td>
</tr>
<tr>
<td>Nonpareil.C</td>
<td>21737</td>
<td>22300</td>
<td>21420</td>
<td>21,819 ab</td>
</tr>
<tr>
<td>Monterey.A</td>
<td>22328</td>
<td>21717</td>
<td>22120</td>
<td>22,055 b</td>
</tr>
<tr>
<td>Monterey.C</td>
<td>23119</td>
<td>21985</td>
<td>21582</td>
<td>22,229 b</td>
</tr>
</tbody>
</table>
NEW SPACING TRIAL, PLANTED 2017

• 17 acres
• 50% Nonpareil, 25% Aldrich, and 25% Kester
• 21’ across the rows
• 12’, 14’, 16’ or 18’ down the row
• ‘Titan’ or ‘Rootpac-R’ rootstock (all treatments repeated on each rootstock)
• Our attempt to reproduce, in northern California, Roger Duncan’s East Stanislaus Co spacing/pruning/rootstock trial.
THANK YOU!

POSTER 47 FOR MORE INFO
ALMOND CULTURE AND ORCHARD MANAGEMENT

Mohammad Yaghmour
Orchard Systems Advisor, UCCE Kern Co.
The almond culture and orchard management project are conducted by UC Farm Advisors from throughout the almond growing areas in California.

In 2017/2018, Nine UC Farm Advisors participated in this project.
How does mechanical topping during 2nd dormant affect 3rd & 4th leaf almond yields?

**Average yield (lbs / acre) – 3rd leaf**

<table>
<thead>
<tr>
<th></th>
<th>Topped</th>
<th>Untopped</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orchard 1</td>
<td>1157 ± 238</td>
<td>1149 ± 248</td>
</tr>
<tr>
<td>Orchard 2</td>
<td>304 ± 11</td>
<td>308 ± 46</td>
</tr>
</tbody>
</table>

No difference in yield between topped and untopped trees in 2017 (3rd leaf). We will measure yields again in 2018.
SACRAMENTO VALLEY ARTHROPOD PEST MONITORING AND IPM EXTENSION

Emily J. Symmes, Area IPM Advisor, Sacramento Valley
Cooperators: FJA Niederholzer and RP Buchner

Project Objectives:

- Monitor the activity of key arthropod (insect & mite) pests of almonds in the Sacramento Valley production region
- Maintain historical records of arthropod pest activity in almonds in the Sacramento Valley
- Disseminate timely IPM information to pest/crop consultants and growers

Extension efforts:

- Pest activity reports disseminated weekly via email list-serves
- Pest activity reports posted weekly on Sacramento Valley Orchard Source website
- Pest activity and seasonal IPM strategies presented at monthly IPM meetings (February – November)

Please visit Poster 99 for project details
Adequate nitrogen (N) nutrition is essential for high volume almond production. Current UC guidelines recommend 20% of annual N budget be applied between hullsplit and leaf drop.

With late harvest varieties (‘Monterey’, ‘Fritz’, etc.) the hullsplit/leaf drop N application may not go out until October.

“Unused” soil nitrate is vulnerable to leaching below the root zone with winter rains, especially in the Sacramento Valley.

Given the environmental risk and limited time/money in fall, is late season N application worth it?...Does fall N improve almond yield?

UN32 or ammonium sulfate was applied to productive, mature ‘Nonpareil’ and ‘Aldrich’ trees under micro-irrigation on Oct 20, 2016 at rate = 0, 30, or 60 lb N/acre.

Fall, 2016 N fertilization did not change 2017 yield in ‘Nonpareil’ or ‘Aldrich’ trees. (Ditto for NP in 2015/16.) See Poster 48 for details.

Ammonium sulfate @ 30 lb N/a. ‘Aldrich’ trees.
SURVEY TO DETERMINE FREQUENCY OF PRUNUS NECROTIC RINGSPOT VIRUS AND OTHER ILARVIRUSES IN NEWLY ESTABLISHED ALMOND ORCHARDS

David Doll, UCCE Merced County

- Once established within an orchard, Prunus necrotic ringspot virus (PNRSV) can spread and reduce yields.
- Often, the disease is introduced through nursery material.
- Survey occurred in which 20 orchards were sampled. Sampling of each variety occurred within the selected orchards for total of 41 samples from 7 different nurseries.
- 4/41 samples tested positive for PNRSV with material sourced from three different nurseries.
- All three of these nurseries participate in viral screen programs, suggesting either budwood was sourced from un-tested trees or false negative/positive.
- This rate of occurrence may indicate a more widespread problem within the industry.
Almond Bloom Disease Fungicide Efficacy Trial
By Brent A. Holtz, UC Farm Advisor in San Joaquin County

Brown Rot Per 100 Flowers

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rates per acre</th>
<th>Brown Rot&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 A19649B Experimental&lt;sup&gt;1,2,3&lt;/sup&gt;, 5.13 fl oz</td>
<td>1.50</td>
<td>a</td>
</tr>
<tr>
<td>14 A20560C Experimental&lt;sup&gt;1,2,3&lt;/sup&gt;, 6.84 fl oz</td>
<td>2.50</td>
<td>a</td>
</tr>
<tr>
<td>04 Aproach + Fontelis 1.67 SC&lt;sup&gt;1,2,3&lt;/sup&gt;, 6 fl oz + 14 fl oz</td>
<td>3.25</td>
<td>a</td>
</tr>
<tr>
<td>16 R-106506 SC Experimental&lt;sup&gt;1,2,3&lt;/sup&gt;, 5.08 fl oz</td>
<td>4.00</td>
<td>a</td>
</tr>
<tr>
<td>13 A20259E Experimental&lt;sup&gt;1,2,3&lt;/sup&gt;, 13.7 fl oz</td>
<td>4.00</td>
<td>a</td>
</tr>
<tr>
<td>15 R-106506 SC Experimental&lt;sup&gt;1,2,3&lt;/sup&gt;, 3.38 fl oz</td>
<td>4.50</td>
<td>a</td>
</tr>
<tr>
<td>11 Quadris Top&lt;sup&gt;1&lt;/sup&gt;, 14 fl oz, Bravo&lt;sup&gt;4&lt;/sup&gt; 4 pt (no DA), Inspire EC&lt;sup&gt;5&lt;/sup&gt;, 7 fl oz</td>
<td>4.50</td>
<td>a</td>
</tr>
<tr>
<td>09 RON94-112 Experimental&lt;sup&gt;1,2,3&lt;/sup&gt;, 43.4 fl oz (no Dyne-Amic)</td>
<td>4.75</td>
<td>a</td>
</tr>
<tr>
<td>05 Aproach + Fontelis 1.67 SC&lt;sup&gt;1,2,3&lt;/sup&gt;, 8 fl oz + 16 fl oz</td>
<td>5.25</td>
<td>ab</td>
</tr>
<tr>
<td>08 RON94-112 Experimental&lt;sup&gt;1,2,3&lt;/sup&gt;, 43.4 fl oz</td>
<td>5.50</td>
<td>ab</td>
</tr>
<tr>
<td>10 RON94-112&lt;sup&gt;1&lt;/sup&gt;, 28.9 fl oz, RON94-374 Experimental&lt;sup&gt;2,3&lt;/sup&gt;, 28.9 fl oz</td>
<td>6.50</td>
<td>ab</td>
</tr>
<tr>
<td>07 RON94-112 Experimental&lt;sup&gt;1,2,3&lt;/sup&gt;, 28.9 fl oz</td>
<td>6.75</td>
<td>ab</td>
</tr>
<tr>
<td>06 Quadris Top&lt;sup&gt;1,2,3&lt;/sup&gt;, 12 fl oz</td>
<td>9.00</td>
<td>abc</td>
</tr>
<tr>
<td>03 Aproach 2.08 SC&lt;sup&gt;1,2,3&lt;/sup&gt;, 12 fl oz</td>
<td>9.00</td>
<td>abc</td>
</tr>
<tr>
<td>17 Timorex Gold&lt;sup&gt;1,2,3&lt;/sup&gt;, 1.5 L/Ha</td>
<td>10.50</td>
<td>abcd</td>
</tr>
<tr>
<td>02 Aproach 2.08 SC&lt;sup&gt;1,2,3&lt;/sup&gt;, 8 fl oz</td>
<td>15.75</td>
<td>bcd</td>
</tr>
<tr>
<td>01 Aproach 2.08 SC&lt;sup&gt;1,2,3&lt;/sup&gt;, 6 fl oz</td>
<td>19.75</td>
<td>cde</td>
</tr>
<tr>
<td>19 Microthiol Disperse&lt;sup&gt;1,2,3&lt;/sup&gt;, 20 lbs</td>
<td>21.00</td>
<td>de</td>
</tr>
<tr>
<td>18 Timorex Gold&lt;sup&gt;1,2,3&lt;/sup&gt;, 2.0 L/Ha</td>
<td>29.75</td>
<td>e</td>
</tr>
<tr>
<td>21 Untreated Control</td>
<td>48.25</td>
<td>f</td>
</tr>
<tr>
<td>22 Untreated Control</td>
<td>49.50</td>
<td>f</td>
</tr>
</tbody>
</table>

<sup>a</sup>Brown Rot = Brown Rot was rated on the Butte variety on March 21st, 10 limbs per tree and 10 blossoms per limb were rated for brown rot infections, determined per 100 blossoms. Data was analyzed by ANOVA with means separated by Fisher’s Protected LSD (α = 0.05) test. Means followed by the same letter are not significantly different. Most treatments significantly reduced the incidence of brown rot when compared to our two untreated controls. See poster 68 for more details.

Scab Incidence

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rates per acre</th>
<th>Incidence&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 A20560C Experimental&lt;sup&gt;1,2,3&lt;/sup&gt;, 6.84 fl oz</td>
<td>4.50</td>
<td>a</td>
</tr>
<tr>
<td>06 Quadris Top&lt;sup&gt;1,2,3&lt;/sup&gt;, 12 fl oz</td>
<td>6.50</td>
<td>a</td>
</tr>
<tr>
<td>13 A20259E Experimental&lt;sup&gt;1,2,3&lt;/sup&gt;, 13.7 fl oz</td>
<td>11.25</td>
<td>a</td>
</tr>
<tr>
<td>12 A19649B Experimental&lt;sup&gt;1,2,3&lt;/sup&gt;, 5.13 fl oz</td>
<td>11.25</td>
<td>a</td>
</tr>
<tr>
<td>11 Quadris Top&lt;sup&gt;1&lt;/sup&gt;, 14 fl oz, Bravo&lt;sup&gt;4&lt;/sup&gt; 4 pt (no DA), Inspire EC&lt;sup&gt;5&lt;/sup&gt;, 7 fl oz</td>
<td>12.50</td>
<td>a</td>
</tr>
<tr>
<td>19 Microthiol Disperse&lt;sup&gt;1,2,3&lt;/sup&gt;, 20 lbs</td>
<td>20.75</td>
<td>ab</td>
</tr>
<tr>
<td>05 Aproach + Fontelis 1.67 SC&lt;sup&gt;1,2,3&lt;/sup&gt;, 8 fl oz + 16 fl oz</td>
<td>37.25</td>
<td>abc</td>
</tr>
<tr>
<td>08 RON94-112 Experimental&lt;sup&gt;1,2,3&lt;/sup&gt;, 43.4 fl oz</td>
<td>38.75</td>
<td>abc</td>
</tr>
<tr>
<td>15 R-106506 SC Experimental&lt;sup&gt;1,2,3&lt;/sup&gt;, 3.38 fl oz</td>
<td>39.25</td>
<td>abc</td>
</tr>
<tr>
<td>10 RON94-112&lt;sup&gt;1&lt;/sup&gt;, 28.9 fl oz, RON94-374 Experimental&lt;sup&gt;2,3&lt;/sup&gt;, 28.9 fl oz</td>
<td>52.25</td>
<td>abc</td>
</tr>
<tr>
<td>16 R-106506 SC Experimental&lt;sup&gt;1,2,3&lt;/sup&gt;, 5.08 fl oz</td>
<td>60.00</td>
<td>bcd</td>
</tr>
<tr>
<td>07 RON94-112 Experimental&lt;sup&gt;1,2,3&lt;/sup&gt;, 28.9 fl oz</td>
<td>68.25</td>
<td>bcd</td>
</tr>
<tr>
<td>09 RON94-112 Experimental&lt;sup&gt;1,2,3&lt;/sup&gt;, 43.4 fl oz (no Dyne-Amic)</td>
<td>72.25</td>
<td>cd</td>
</tr>
<tr>
<td>04 Aproach + Fontelis 1.67 SC&lt;sup&gt;1,2,3&lt;/sup&gt;, 6 fl oz + 14 fl oz</td>
<td>84.75</td>
<td>cd</td>
</tr>
<tr>
<td>02 Aproach 2.08 SC&lt;sup&gt;1,2,3&lt;/sup&gt;, 8 fl oz</td>
<td>87.75</td>
<td>cde</td>
</tr>
<tr>
<td>20 Fontelis&lt;sup&gt;1,3&lt;/sup&gt;, 20 fl oz, Regalia&lt;sup&gt;2&lt;/sup&gt;, 2 quarts</td>
<td>100.75</td>
<td>def</td>
</tr>
<tr>
<td>21 Untreated Control</td>
<td>135.75</td>
<td>ef</td>
</tr>
<tr>
<td>01 Aproach 2.08 SC&lt;sup&gt;1,2,3&lt;/sup&gt;, 6 fl oz</td>
<td>138.25</td>
<td>ef</td>
</tr>
<tr>
<td>22 Untreated Control</td>
<td>140.50</td>
<td>fg</td>
</tr>
<tr>
<td>17 Timorex Gold&lt;sup&gt;1,2,3&lt;/sup&gt;, 1.5 L/Ha</td>
<td>146.00</td>
<td>fg</td>
</tr>
<tr>
<td>18 Timorex Gold&lt;sup&gt;1,2,3&lt;/sup&gt;, 2.0 L/ Ha</td>
<td>158.25</td>
<td>gh</td>
</tr>
<tr>
<td>03 Aproach 2.08 SC&lt;sup&gt;1,2,3&lt;/sup&gt;, 12 fl oz</td>
<td>197.50</td>
<td>h</td>
</tr>
</tbody>
</table>

<sup>a</sup>Incidence = number of nuts that have scab lesions on 100 nuts randomly sampled. 222 nuts per tree were randomly sampled on August 3, and taken back to the laboratory in order to determine incidence and severity.

Data was analyzed by ANOVA with means separated by Fisher’s Protected LSD (α = 0.05) test. Means followed by the same letter are not significantly different. Most treatments significantly reduced the incidence of almond scab when compared to our two untreated controls. See poster 68 for more details.
PRE-PLANT SOIL FUMIGATION OR POST-PLANT SOLARIZATION FOR CONTROL OF VERTICILLIUM WILT DISEASE

Roger Duncan, UC Cooperative Extension, Stanislaus County

- New almond orchards expanding into traditional row crop land (tomatoes, melons, etc.)
- Many Westside orchards affected by Verticillium wilt disease
- Will pre-plant treatments reduce disease severity?
  - Testing:
    - Preplant: fumigation with Telone II, chloropicrin, Dominus
    - Postplant: black polyethylene film
- Trees planted November 2016
- Will record disease severity, tree performance and yield response
- Results pending. Vert expected in spring 2018!
85-90 tons/acre wood mulch application was detrimental to growth of young almond trees in comparison to other pre-plant agricultural waste product amendments and industry standard practices after one growing season.

Soil chemical and biological indicators suggest wood mulch significantly increases soil microbial biomass, organic carbon, and total nitrogen levels in the soil within the first year of application.
Sodium, Chloride and Boron Accumulation in Almonds – Westside
Can Salt Levels in Woody Tissue Forecast Future Toxicity?
Blake Sanden, Patrick Brown

Conductance-Water stress 6/17/2015

Normalized Differential Vegetative Index (NDVI) 8/23/2017

Area 4 – more saline
Nov 2015: Soil ECe 6.1 dS/m
B 1.6 ppm
Nov 2017: Soil ECe 4.8 dS/m
B 0.9 ppm

Maybe 1% trees with bad gummosis

CONCLUSION
No real increase in Na or B in the xylem or scion as soil salinity increased. Cl was higher in the scion.

Area 1 – slightly saline
Nov 2015: Soil ECe 1.5 dS/m
B 0.6 ppm
Nov 2017: Soil ECe 3.6 dS/m
B 0.6 ppm

Nonpareil and Monterey on Hansen rootstock

Area 1

Conductance-Water stress 6/17/2015

NDVI – biomass 6/17/2015

Area 2

10TS Edge E
field to N

35.6434829
-119.809877

35.634510
-119.806173

Area 3

15R 15T

35.643200
-119.813270

15R 97TS

35.6396033
-119.813263

Area 4

Almond Board salinity and boron concentration survey

10T 10R

35.634510
-119.806173

10R

35.643200
-119.813270

5th leaf tree size 10/24/2017

Rootstock Xylem (trunk) Salts 10/24/2017

Scion Xylem (trunk core) Salts 10/24/2017
INVESTIGATION OF HULL ROT CAUSAL AGENTS, AND ENVIRONMENTAL CONDITIONS CONDUCIVE TO DISEASE DEVELOPMENT IN KERN COUNTY

MOHAMMAD YAGHMOUR, UCCE KERN

Hull Rot Incidence

Pathogenicity Test

Stem Water Potential

Leaf Analysis
THANK YOU!

Please visit our posters for more information
INTEGRATION OF HIGHER TREE DENSITY AND MINIMAL PRUNING FOR EFFICIENT ALMOND PRODUCTION

Roger Duncan, UCCE, Stanislaus County

University of California
Agriculture and Natural Resources
GOAL WHEN DESIGNING AN ALMOND ORCHARD – MAXIMIZE YIELD POTENTIAL BY MAXIMIZING LIGHT CAPTURE:

• Capture as much sunlight as early and for as long as possible.
• Each 1% of intercepted sunlight ~ 50 pounds of yield potential.
• Does higher tree density = higher yield in short term? Long term??
• What is the limit? Do high density orchards crash over time?
• What role does pruning play in maintaining yield?
ALMOND SPACING & PRUNING TRIAL

• Planted fall, 1999
• 37 acres
• Four tree densities
  - 10’ x 22’ (198 trees / acre)
  - 14’ x 22’ (141 trees / acre)
  - 18’ x 22’ (110 trees / acre)
  - 22’ x 22’ (90 trees per acre)
• Overlaid with four pruning strategies and two rootstocks (Nemaguard & Hansen)
The Effect of Tree Spacing on Cumulative Yield Through 18th Season

Carmel on Nemaguard

Smaller variety on medium vigor rootstock: Cumulative yield directly related to tree spacing.

<table>
<thead>
<tr>
<th>Spacing</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>10’ x 22’</td>
<td>45,338 lb /a</td>
</tr>
<tr>
<td>14’ x 22’</td>
<td>42,782 lb / a</td>
</tr>
<tr>
<td>18’ x 22’</td>
<td>40,884 lb / a</td>
</tr>
<tr>
<td>22’ x 22’</td>
<td>38,275 lb / a</td>
</tr>
</tbody>
</table>
The Effect of Tree Spacing on Cumulative Yield Through 18th Season

Nonpareil on Nemaguard

- 10’ x 22’: 43,660 lb / a
- 14’ x 22’: 43,347 lb / a
- 18’ x 22’: 41,479 lb / a
- 22’ x 22’: 39,060 lb / a

4,600 lb.
Spacing on Cumulative Yield Through 18th Leaf
Nonpareil on Hansen

Moderate spacing may be best for large variety on vigorous rootstock.
THE EFFECT OF TREE SPACING ON SCAFFOLD SPLITTING OF ALMOND TREES

- Tree failure was most severe in widely planted (large) trees (5th leaf).
- Tree spacing had larger impact on tree failure than pruning.
The Effect of Tree Spacing on Trunk Shaker Injury

July, 2012. 13th leaf

Percentage of Trees with Shaker Injury

<table>
<thead>
<tr>
<th>Tree Spacing</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>10’ x 22’</td>
<td>10%</td>
</tr>
<tr>
<td>14’ x 22’</td>
<td>15%</td>
</tr>
<tr>
<td>18’ x 22’</td>
<td>20%</td>
</tr>
<tr>
<td>22’ x 22’</td>
<td>30%</td>
</tr>
</tbody>
</table>
THE INFLUENCE OF TREE SPACING ON THE NUMBER OF REPLANTED TREES (ON ALL 37 ACRES)
## THE INFLUENCE OF TREE SPACING ON MISSING CANOPY

<table>
<thead>
<tr>
<th>Tree Spacing</th>
<th>Cumulative Number of Replants</th>
<th>Square Footage of Missing Canopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 x 22</td>
<td>39</td>
<td>8,580</td>
</tr>
<tr>
<td>14 x 22</td>
<td>86</td>
<td>26,488</td>
</tr>
<tr>
<td>18 x 22</td>
<td>121</td>
<td>47,916</td>
</tr>
<tr>
<td>22 x 22</td>
<td>157</td>
<td>75,988</td>
</tr>
</tbody>
</table>

Through the 16th leaf
EFFECT OF TREE DENSITY ON YIELD TO DATE:

• Yield advantage to tighter spacing is highly dependent on inherent tree vigor
  - Smaller trees (varieties, rootstocks, etc.) will benefit most from tight spacing
  - Benefit may persist throughout orchard’s life
  - Vigorous trees may not have higher yields at higher density.
  - Active canopy is the ticket, not the number of trunks per acre

• Advantages other than yield (smaller trees, easier to shake, fewer structural problems, fewer mummies, etc.)

• Perhaps more risk of planting too wide than too close??
1) Standard trained, standard annual pruning
- 3 scaffolds
- medium annual pruning to maintain open centers

2) Standard trained, unpruned after 2\textsuperscript{nd} dormant
- 3 scaffolds
- unpruned after second dormant season

3) Minimally trained, “minimally” pruned
- 4-6 scaffolds
- 3 pruning cuts annually

4) Untrained & “unpruned” forever
- Limbs interfering with machinery removed
Standard trained & pruned vs. Untrained & unpruned.

End of 3rd Season.
## The Effect of Pruning on 2017 (18<sup>th</sup> Leaf) & Cumulative Yield

<table>
<thead>
<tr>
<th>Training &amp; Pruning Strategy</th>
<th>Nonpareil</th>
<th></th>
<th>Carmel</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2017 Yield (lb. / a)</td>
<td>Cumulative</td>
<td>2017 Yield (lb. / a)</td>
<td>Cumulative</td>
</tr>
<tr>
<td>Trained to 3 scaffolds; Annual, moderate pruning</td>
<td>2671 a</td>
<td>39,383</td>
<td>1583 a</td>
<td>36,391</td>
</tr>
<tr>
<td>Trained to 3 scaffolds; Unpruned after 2&lt;sup&gt;nd&lt;/sup&gt; year</td>
<td>2557 ab</td>
<td>40,277</td>
<td>1583 a</td>
<td>38,947</td>
</tr>
<tr>
<td>Trained to multiple scaffolds; Three annual pruning cuts</td>
<td>2384 b</td>
<td>38,073</td>
<td>1521 a</td>
<td>38,189</td>
</tr>
<tr>
<td>No scaffold selection; No annual pruning</td>
<td>2554 ab</td>
<td>40,498</td>
<td>1635 a</td>
<td>40,474</td>
</tr>
</tbody>
</table>
EFFECT OF PRUNING ON YIELD TO DATE

• Pruning has not increased or sustained yield in the short or long term. Pruning has either had no significant effect or has reduced yield.

• 18 years x $275 pruning / shredding costs = $4950

• Decrease in yield by about 1000 to 3500 pounds = loss of ~$2500 - $9000 / acre
  - Cumulative loss from annual pruning likely $7,500 - $14,000 / acre
REMARKS ON PRUNING

• Sometimes pruning is needed for safety, equipment access, removing broken branches, limb cankers, etc.

• Reason to prune should justify expense and yield loss
Thank you for your Attention

See you at the posters 3:00 – 5:00

Roger Duncan
209-525-6800
raduncan@ucdavis.edu
Physiology of carbohydrate management in trees
Anna Davidson, Aude Tixier and Maciej Zwieniecki
CARBOHYDRATES (NSC'S), THE CURRENCY OF THE ALMOND TREE

Carbohydrates provide energy for:
- Growth
- Defense
- Reproduction
- Yield

Soluble carbohydrates (sugar) = “cash” that flows around the tree

Starch = savings account

Carbohydrate Observatory = accelerated research.
Joy Valdez
Walnut Grower in Lake Co.
WE ANALYZE SAMPLES IN THE LAB AND UPLOAD RESULTS TO OUR WEBSITE.
PRE-DORMANCY IS VITAL FOR CHO RECOVERY

2017 pre dORMANCY level

2016 winter level

2017 bloom

Carbohydrate recovery

2017 harvest

January June October March

almond pistachio walnut

Species

almond pistachio walnut

months:

January March June October

Julian Day

peak CSN

200

100

0

2017 harvest
CARBOHYDRATE OBSERVATORY

Almond seasonal pattern of NSCs

Month (Dec 2015 till Jan 2017)

- NSC_twig_total
- Relative growth of stem

Legend:
- dormancy
- vegetative phase
- stem relative growth
ALMOND
CARBOHYDRATES DECREASE WITH INCREASING CHILL HOURS/PORTIONS
CARBOHYDRATES DECREASE WITH INCREASING LATITUDE AND INCREASE WITH TREE AGE

Winter carbohydrate content in wood of almond

- Latitude
- Year Planted
CARBOHYDRATE OBSERVATORY

Want to Participate?
Contact Anna Davidson
Email: adavidson@ucdavis.edu
Phone: (815) 212-4409
THREE-DIMENSIONAL MODELING OF ALMOND ORCHARDS

Project Cooperators: Ted DeJong, Matthew Gilbert, Ken Shackel – U.C. Davis Dept. Plant Sciences
COMPUTER-AIDED DESIGN AND ANALYSIS

The “Third Industrial Revolution”
MODEL COMPONENTS

• Sunlight interception
• Microclimate
• Evapotranspiration
• Photosynthesis
• Carbohydrate transport
• Growth/structure
• Yield
• Disease risk
INITIAL DATA: TRANSPIRATION & PH

[Graphs showing light response and temperature effects on a plant]

- Light Response Graph: 
  - X-axis: Light intensity (W/m²) 
  - Y-axis: Photosynthesis rate (μmol/m²/s) 
  - Data points and curve indicating increasing photosynthesis with light intensity.

- Temperature Graph: 
  - X-axis: Temperature (°C) 
  - Y-axis: Transpiration rate (mmol/m²/s) 
  - Data points and curve showing decreasing transpiration rate with temperature.
INITIAL DATA: LIDAR SCANNING
INITIAL DATA: LIDAR SCANNING
SIMULATION OF EVAPOTRANSPIRATION
THANK YOU

Contact:

bnbailey@ucdavis.edu
baileylab.ucdavis.edu

This research was supported by the Almond Board of California project #17-PREC1-Bailey
BACK-UP IMAGES IN CASE THE MOVIE DIDN’T WORK....
BACK-UP IMAGES IN CASE THE MOVIE DIDN'T WORK....
BACK-UP IMAGES IN CASE THE MOVIE DIDN’T WORK....
BACK-UP IMAGES IN CASE THE MOVIE DIDN’T WORK....
BACK-UP IMAGES IN CASE THE MOVIE DIDN’T WORK....
Measuring Canopy Light Interception

Bruce Lampinen
Department of Plant Sciences
University of California at Davis

4000+ kernel pounds per acre
2nd Generation mule light bar

Adjustable from 2 to 11 meters in width
Normal speed of travel is 10 km/hr so we can map about 20 km within 1 hour of the time the sun is directly overhead.

We set up a portable weather station with temp, RH, windspeed and PAR sensors outside orchard.
Self contained hydraulic system for operating augers, autosampler and elevator

Trimble GPS acts as datalogger to collect continuous yield data

Front skirt to prevent nuts from overflowing as cart fills

Wireless controller for hydraulically operated auto sampler
We have found the best managed orchards (but very few) can alternate around this line (50 kernel lbs/1% intercepted) after about 5 years of age.

Regression through all data (40 kernel lbs/1% intercepted).
Broken up by number of trees per acre

Yield (kernel lb/ac)

Midday PAR interception (%)
28% PAR int. $\times 50 = 1400$ kernel lb/ac potential

48% $\times 50 = 2400$ lb/ac potential

64% $\times 50 = 3200$ lb/ac potential

82% $\times 70 = 4,100$ lb/ac potential
PAR = photosynthetically active radiation (mmol$^{-2}$ sec$^{-1}$)

121 trees/acre (18’ x 20’)

818 trees/acre (5’ x 11’)

PAR interception

Tree spacing
- 18’ x 20’
- 5’ x 11’

PAR interception x incoming PAR

Time (PST)
The images show three different plots of data related to photosynthetically active radiation (PAR) and PAR interception in different tree spacings. The top plot shows PAR from a weather station, indicating a peak around midday. The middle plots illustrate PAR interception with two different spacings: 18' x 20' and 5' x 11'. The bottom plot depicts the relationship between PAR interception and incoming PAR, showing a peak in PAR interception at midday and a decrease as the day progresses.
Yield potential based on midday PAR interception

<table>
<thead>
<tr>
<th>Planting</th>
<th>PAR int. (%)</th>
<th>Yield potential (kernel lb/ac)</th>
<th>Actual yield (kernel lb/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5’ x 11’</td>
<td>44</td>
<td>2200</td>
<td>1324</td>
</tr>
<tr>
<td>18’ x 21’</td>
<td>83</td>
<td>4150</td>
<td>~3600</td>
</tr>
</tbody>
</table>
Conclusions

• The most productive almond orchards in our studies can produce about 50 kernel lb/ac (and the average about 40)

• Across the range of planting densities in our studies (80-202 trees per acre) at maturity there do not appear to be any clear density related differences in production potential

• There is some indication that higher density plantings than those in our study may potentially be able to intercept more PAR over the course of the day for a given level of midday PAR interception

• However, keeping productivity up at this density will require breeding and training work to create smaller tree structures that do not require continual hedging or training to keep trees within size range of over the row harvesters as well as new machinery for harvest and field operations
Field name: Yolo County Almond Rootstock Trial
Date: July 24, 2017
Crop: Almond
Start Time: 11:49 AM
Number of Measurements: 12
Average PAR: 70%
Yield potential: 2450-3500 lbs/ac
Estimated nitrogen needs: 166-237 lbs N/ac
Questions?

Thanks to the Almond Board of California for supporting this work.
CEUS – NEW PROCESS

Certified Crop Advisor (CCA)
• Sign in and out of each session you attend.
• Pickup verification sheet at conclusion of each session.
• Sign in sheets are located at the back of each session room.

Pest Control Advisor (PCA), Qualified Applicator (QA), Private Applicator (PA)
• Pickup scantron at the start of the day at first session you attend; complete form.
• Sign in and out of each session you attend.
• Pickup verification sheet at conclusion of each session.
• Turn in your scantron at the end of the day at the last session you attend.

Sign in sheets and verification sheets are located at the back of each session room.
What’s Next

Wednesday, December 6 at 12:00 p.m.

• Luncheon Presentation – Hall C

  The Future of Agriculture: Innovation, Ingenuity, Perseverance
  Speaker: Steve Forbes

Luncheon is ticketed and is sponsored by Yosemite Farm Credit