AGENDA

• Christine Gemperle, Gemperle Orchards, moderator
• Brian Leahy, DPR
• Joel Kimmelshue, Land IQ
• Gabriele Ludwig, Almond Board of California
ALMOND ORCHARD 2025 GOALS

- Water
- Harvest Dust
- Pest Management
- Zero Waste
REDUCE THE AMOUNT OF WATER USED TO GROW A POUND OF ALMONDS BY 20%

ACHIEVE ZERO WASTE IN OUR ORCHARDS BY PUTTING EVERYTHING WE GROW TO OPTIMAL USE

REDUCE DUST DURING ALMOND HARVEST BY 50%

INCREASE ADOPTION OF ENVIRONMENTALLY FRIENDLY PEST MANAGEMENT TOOLS BY 25%

ACHIEVE ZERO WASTE IN OUR ORCHARDS BY PUTTING EVERYTHING WE GROW TO OPTIMAL USE
INCREASE ADOPTION OF ENVIRONMENTALLY FRIENDLY PEST MANAGEMENT TOOLS BY 25%
AGENDA

• Brian Leahy, DPR
2018 Acreage Update and Pest Management Applications

Joel Kimmelshue, PhD, CPSS - Land IQ
Cooperators and Resources

• Primary Cooperators
  – Almond Board of California (ABC)
  – Land IQ

• Lines of Evidence
  – United States Department of Agriculture (USDA) National Agricultural Imaging Program (NAIP) imagery
  – Landsat and other imagery
  – Agronomic and Remote Sensing Expertise
  – Grower Knowledge
  – California Department of Water Resources (DWR) County Crop Mapping
  – USDA-National Agricultural Statistics Service (NASS) CropScape Mapping
  – USDA-NASS Tabular Records
  – California Department of Pesticide Regulation (DPR) Records
  – County Agricultural Commissioner Crop Reports
Almond Acreage Mapping

- **Bearing Acreage**
  - Spatial representation of almond orchards
  - 98.5% accurate

- **Non-Bearing Acreage**
  - Numerical estimate of non-bearing acreage
  - 98.1% accurate
  - Finalized two years after initial release

- **Initial Acreage**
  - Current year spatial representation of bearing acreage
  - Current year numeric estimate of non-bearing acreage

- **Final Acreage**
  - Finalized two years after the initial acreage is released
  - Spatial representation of bearing acreage
  - Young orchards are visually confirmed through ground truthing and present the characteristics of an almond orchard in spatial analysis

<table>
<thead>
<tr>
<th>2016</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Acreage 2016</td>
<td>Initial Acreage 2018</td>
<td>Initial Acreage 2019</td>
<td>Initial Acreage 2020</td>
<td>Initial Acreage 2021</td>
</tr>
<tr>
<td>Final Acreage 2014</td>
<td>Final Acreage 2016</td>
<td>Final Acreage 2017 (TBD)</td>
<td>Final Acreage 2018</td>
<td>Final Acreage 2019</td>
</tr>
</tbody>
</table>
### 2016 Final Acreage

- The initial acreage assessment over-estimated the total acres by approximately 5,200 acres.
- Overall, the difference in total acreage between the initial release and final release was less than 0.4%.

<table>
<thead>
<tr>
<th>2016 Acreage</th>
<th>Initial</th>
<th>Final</th>
<th>Difference</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bearing</td>
<td>981,813</td>
<td>982,364</td>
<td>551</td>
<td>0.06%</td>
</tr>
<tr>
<td>Non-Bearing</td>
<td>280,102</td>
<td>274,307</td>
<td>(5,795)</td>
<td>-2.07%</td>
</tr>
<tr>
<td>Total</td>
<td>1,261,915</td>
<td>1,256,671</td>
<td>(5,244)</td>
<td>-0.42%</td>
</tr>
</tbody>
</table>
2018 Initial Acreage Estimate

- First time an acreage number has been released in the crop year.
- Bearing Acreage has increased by 106,293 acres since 2016.
- Accounts for removals.
- Non-bearng acreage (1, 2, and 3 year old orchards) is estimated at 289,133

<table>
<thead>
<tr>
<th>2018 Acreage</th>
<th>Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bearing</td>
<td>1,088,657</td>
</tr>
<tr>
<td>Non-Bearing</td>
<td>289,133</td>
</tr>
<tr>
<td>Total</td>
<td>1,377,790</td>
</tr>
</tbody>
</table>
Acreage Results - Bearing

- USDA-NASS and Land IQ Acreage Comparisons

<table>
<thead>
<tr>
<th>Year</th>
<th>Land IQ</th>
<th>USDA-NASS</th>
<th>Difference</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>810,386</td>
<td>770,000</td>
<td>40,386</td>
<td>5.24%</td>
</tr>
<tr>
<td>2012</td>
<td>885,575</td>
<td>820,000</td>
<td>65,575</td>
<td>8.00%</td>
</tr>
<tr>
<td>2014</td>
<td>938,441</td>
<td>870,000</td>
<td>68,441</td>
<td>7.87%</td>
</tr>
<tr>
<td>2016</td>
<td>982,364</td>
<td>940,000</td>
<td>42,364</td>
<td>4.51%</td>
</tr>
<tr>
<td>2018</td>
<td>1,088,657</td>
<td>1,070,000</td>
<td>18,657</td>
<td>1.74%</td>
</tr>
</tbody>
</table>

- Key Conclusions
  - Accuracy approaching 99% (spatial accuracy) – actual acreage is higher
  - Land IQ is a spatial product that allows for other spatial overlays and analyses
  - USDA-NASS has closed the gap because they have had access to Land IQ data
  - Allows for very accurate estimations of yield because: acres, age, and location known
Acreage Results – Non Bearing

• USDA-NASS and Land IQ Acreage Comparisons

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2012</th>
<th>2014</th>
<th>2016</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land IQ</td>
<td>124,568</td>
<td>118,595</td>
<td>189,505</td>
<td>274,307</td>
<td>289,133</td>
</tr>
<tr>
<td>USDA-NASS(^1)</td>
<td>85,000</td>
<td>110,000</td>
<td>170,000</td>
<td>300,000</td>
<td>NA</td>
</tr>
<tr>
<td>Difference</td>
<td>39,568</td>
<td>8,595</td>
<td>19,505</td>
<td>-25,693</td>
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</tr>
<tr>
<td>% Difference</td>
<td>46.55%</td>
<td>7.81%</td>
<td>11.47%</td>
<td>-8.56%</td>
<td></td>
</tr>
</tbody>
</table>

• Key Conclusions
  • A numerical estimate based on up to 4,000 miles of ground truthing
  • Defined as 1, 2 and 3 year old orchards
  • Land IQ can spatially map 3 year old orchards but not 1 and 2 year old orchards
  • Updated to final estimate 2 years later by mapping all orchards
### Acreage Results – Total Acreage

- **USDA-NASS and Land IQ Acreage Comparisons**

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<th>2014</th>
<th>2016</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Land IQ</strong></td>
<td>934,954</td>
<td>1,004,170</td>
<td>1,127,946</td>
<td>1,256,671</td>
<td>1,377,790</td>
</tr>
<tr>
<td><strong>USDA-NASS(^1)</strong></td>
<td>855,000</td>
<td>930,000</td>
<td>1,040,000</td>
<td>1,240,000</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Difference</strong></td>
<td>79,954</td>
<td>74,170</td>
<td>87,946</td>
<td>16,671</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>% Difference</strong></td>
<td>9.35%</td>
<td>7.98%</td>
<td>8.46%</td>
<td>1.34%</td>
<td>N/A</td>
</tr>
</tbody>
</table>

- **Key Conclusions**
  - Spatial accuracy is greater than 98% - Acreage values are more accurate
  - USDA-NASS has closed the gap because they have had access to Land IQ data
  - Will be mapping on an annual basis beginning in 2019
  - Preliminary estimate for 2019 available by 2019 annual conference
Age Analysis

- Question: Can you also determine the age of each orchard?
- Answer: Yes
  - Once orchards are mapped, only then can age be determined
  - A backwards looking approach (through 1984) at various imagery sources is conducted
  - Once “signature” appears as open ground, then this establishes planting date
  - +/- 1-2 years
  - Accuracy = 90-95%
- Significance: Potential Uses
  - Yield forecasts/enhancements
  - Biomass/carbon accumulation
Spatial Information – ABC External Viewer: [www.almonds.com/maps](http://www.almonds.com/maps)

- Viewable maps to be released before the end of 2018
Tabular Information: www.almonds.com/growers/resources/crop-forecasts

• Data to be released before the end of 2018
Applications of Almond Mapping
School Proximity Analysis

• Question: Driven by regulations at the Department of Pesticide Regulation, can you determine how many orchards would be impacted by a notification to spray rule?

• Answer: Yes
  • By knowing where almonds are on an orchard by orchard basis AND the location of schools and daycares, a proximity analysis was conducted to determine how many orchards would be impacted.

• Significance
  • Approximately 51,450 acres would be impacted
  • Average orchard size was 34 acres
  • Representing 1,513 orchards
Applications of Almond Mapping Chlorpyrifos Assessment

• Question: Driven by regulations at the Department of Pesticide Regulation, can you determine how many orchards would be impacted by setback distances required for sensitive sites?

• Answer: Yes
  • By knowing where almonds are on an orchard by orchard basis, a random sample set of 3,000 orchards were selected for analysis. Buffer zones were drawn around each polygon and sensitive sites identified

• Significance
  • The area with the largest impact was east of the San Joaquin River where nearly 575,000 acres would be impacted by the 500 foot buffer.
  • On the west side of the San Joaquin River, slightly more than 75,000 acres would be impacted by a 500 foot buffer.
  • In the Sacramento Valley, 130,000 acres would be impacted by the 500 foot buffer.
Questions: Joel Kimmelshue, jkimmelshue@landiq.com, 916.517.2482
How Do Regulations Outside of the United States Affect Your Pest Control Tool Options?

Gabriele Ludwig, Ph.D.
Director, Sustainability & Environmental Affairs
Almonds are Highly Exported: 2017/18 California Almond Shipment Overview

Source: Almond Board of California
Your nuts are likely going to several different countries around the world,

And each has different pesticide regulations....
Almond Processing – Sort by Size & Quality

→ can’t grow to a particular market’s specifications
General Trends in Key Markets re Pesticide Regulations

• More countries are setting up their own regulatory and enforcement systems.
  – Less reliance on Codex or other key country MRLs
  – Countries that have moved to their own MRLs
    • Japan (2007)
    • South Korea (2017 for tree nuts/2019 most other crops)
    • Hong Kong (2014)
  – Countries are revising their food safety systems
    • China, Vietnam, Indonesia, India, etc.
  – Many do not have an import tolerance setting process

• The analytical testing can detect lower levels of residues
European Union
European Union – Fosetyl-Al/Phosphite

Fall 2013: EU changes definition: phosphonate under Fosetyl regardless of source

2mg/kg

Dec 2014: Walnut recall in Germany due to “fosetyl-Al”

75 mg/kg (Fall, 2014)

Effective until Dec 31, 2015

Generate science-based information

Rational & purpose for use
true plant health effects

Monitoring data
domestic/import data

Analytical Methods
multiplier in MRL definition?

Field trials
develop residue data for MRL setting with IR-4

2014-2016

Summer 2015: Standing Committee adopted legislation to extend tMRL for 6 tree nuts

February 2016: Publication of Regulation extended tMRL to March 2019 and retroactive to 1 January 2016

Sept 2016 Dossier submitted by Tree Nuts proposing permanent MRL for tree nut group

Autumn 2016-February 2018

February 2018, Standing Committee adopted EFSA proposed 500 ppm MRL as fosetyl-Al. Awaiting publication
European Union: Cut-Off Criteria

Legislation was passed by the European Parliament in 2008

Endocrine Disruptors, Carcinogens, Mutagens, & Toxic for Reproduction

The EU is reviewing all pesticides to understand if they have endocrine disruptor, carcinogen, mutagen, or toxic for reproduction properties. EU legislation requires that use of such compounds be “cut-off” from use in the EU. Furthermore, once a compound has been “cut-off”, EU farmers will not be allowed to use these compounds and import Maximum Residue Limits (MRLs) will be removed.

US and Global Risk Assessment Process

• Hazard x Exposure = Risk to human health
• To do a complete risk assessment, scientists need both how hazardous the compound is, as well as risk of exposure to the human body. (e.g. skin contact, diet, water, air etc.)

EU Risk Assessment Process

• Hazard x Exposure = Risk to human health
• If a compound meets one of the cut-off criteria, then EU only considers the hazard. It does not account for human exposure, creating an incomplete picture of risk to human health.
Example of Impacts of Cut-off Criteria: Iprodione (Rovral)

- Among first compounds reviewed under Cut-Off Criteria
- Different registrants in the EU vs the US
  - EU registrant had already stopped selling it in the EU.
- November 2017: Registration cancellation within the EU announced for March/June 2018
  - But the existing MRLs (0.2 ppm for almonds) are still in place
- June 2018/ September 2018: EU member states vote to reset all MRLs to the default 0.01 ppm
- July 2019/August 2019: the lowered MRLs will take effect

Almond Season:
- February/March 2018: Almond bloom
- Aug/Sept 2018: Harvest
- Sept 2018-Aug 2019: shipments to EU
- Oct 2018- Dec 2019: placement on EU retail shelves

- Chaos preceding and during bloom whether can use iprodione as not sure when MRLs will change
  - Growers already had iprodione in hand.
  - Handlers dealing with buyers
- EU buyers demanding it not be used while still legal to use in the EU/ still have legal MRL.
- Unclear/uncertainty for channels of trade
  - Within EU official notification language, EU can provide 6 month transition period allowing product in trade for 6 months past MRL reset to default date and if treated before changed the MRL date.
  - Absolutely no consideration given to different shelf lives of products
- US Registrant submitted import MRL packages to several countries and two have refused to take it on despite cut-off legislation not amending the MRL setting legislation
Possible Impact of the Cut-Off Criteria on Disease Control: example Brown Rot Blossom Blight

- Currently 20 different active ingredients (AIs) or AI combinations listed as providing control of Brown Rot in almonds.*
- Includes AIs from 8 different Fungicide Resistance Category (FRAC group)

<table>
<thead>
<tr>
<th>Fungicides for use for Blossom Brown Rot (Monilinia) in Almonds per UC-IPM website</th>
<th>Resistance Category (FRAC)</th>
<th>2016 CA acres treated (ppm)</th>
<th>US MLR (ppm)</th>
<th>EU MRL (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>propiconazole</td>
<td>3</td>
<td>345,737</td>
<td>0.1</td>
<td>0.01</td>
</tr>
<tr>
<td>fenbuconazole</td>
<td>3</td>
<td>19,419</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>difenoconazole</td>
<td>3</td>
<td>219,774</td>
<td>0.03</td>
<td>0.05</td>
</tr>
<tr>
<td>metconazole</td>
<td>3</td>
<td>431,378</td>
<td>0.04</td>
<td>0.05</td>
</tr>
<tr>
<td>tebuconazole</td>
<td>3</td>
<td>121,334</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>myclobutanil</td>
<td>3</td>
<td>3,563</td>
<td>0.01</td>
<td>0.05</td>
</tr>
<tr>
<td>difenoconazole/cyprodinil</td>
<td>3/9</td>
<td>219,774/199,975</td>
<td></td>
<td></td>
</tr>
<tr>
<td>azoxystrobin</td>
<td>11</td>
<td>381,705/345,737</td>
<td>0.02</td>
<td>0.01</td>
</tr>
<tr>
<td>azoxystrobin/propiconazole</td>
<td>11/3</td>
<td>381,705</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pyraclostrobin/boscalid</td>
<td>11/7</td>
<td>420,224/190,130</td>
<td>0.04/0.7</td>
<td>/0.05</td>
</tr>
<tr>
<td>pyraclostrobin/fluxapyroxad</td>
<td>11/7</td>
<td>420,224/230,095</td>
<td>0.04/0.06</td>
<td>/0.04</td>
</tr>
<tr>
<td>trifloxystrobin</td>
<td>11</td>
<td>308,378</td>
<td>0.04</td>
<td>0.02</td>
</tr>
<tr>
<td>fluopyram/trifloxystrobin</td>
<td>7/11</td>
<td>380,521/308,377</td>
<td>0.05</td>
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</tr>
<tr>
<td>thiophanate methyl</td>
<td>1</td>
<td>48,490</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>iprodione</td>
<td>2</td>
<td>388,110</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>pyramethanil</td>
<td>9</td>
<td>104,172</td>
<td>0.2</td>
<td>0.2</td>
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<tr>
<td>cyprodinil</td>
<td>9</td>
<td>199,975</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>captan</td>
<td>M4</td>
<td>24,366</td>
<td>0.25</td>
<td>0.07</td>
</tr>
<tr>
<td>fenhexamid</td>
<td>17</td>
<td>0</td>
<td>0.02</td>
<td>0.02</td>
</tr>
</tbody>
</table>

* From UC-IPM Website for almonds: http://ipm.ucanr.edu/PMG/r3100111.html
Possible Impact on Disease Control: example Brown Rot Blossom Blight

Based on a 2009 COLEACP assessment of compounds possibly affected by cut-off criteria*. Other lists have other compounds….

➔ 12 of 20 Alts/ combinations might be affected = 8 left

➔ Resistance management harder: Reduce FRAC from 8 to 5
   ➔ Already have resistance to FRAC 11….

➔ Note the compounds are not equally effective.


Fungicides for use for Blossom Brown Rot (Monilinia) in Almonds per UC-IPM website

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<thead>
<tr>
<th>Resistance Category (FRAC)</th>
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EU cut-off criteria will make pest management in almonds more complicated….
Other Uncertainties with Cut-off Criteria and other Issues in the EU

- Compounds can get hung up by a metabolite that meets one or more of the cut-off criteria
  - Example: buprofezin and the possibility of anillin as a metabolite.

- No good list(s) of potential active ingredients possibly affected by cut-off criteria

- Need a reasonable transition system in the EU that accounts for shelf-lives of different food products.
  - FDA good model – if can prove application occurred when legal and within old MRL, then OK.

- Import tolerance system…..

- Other issues in the EU:

  **Glyphosate registration nearly cancelled**
  - Even though EFSA didn’t have concerns
  - Issue highly political
  - Individual EU countries working on phaseouts

  **Neonics Banned for Bee Health**
  - Clothianidin
  - Imidacloprid
  - Thiamethoxam
Thank You!

Gabriele Ludwig Ph.D.
Director, Sustainability & Environmental Affairs
gludwig@almondboard.com