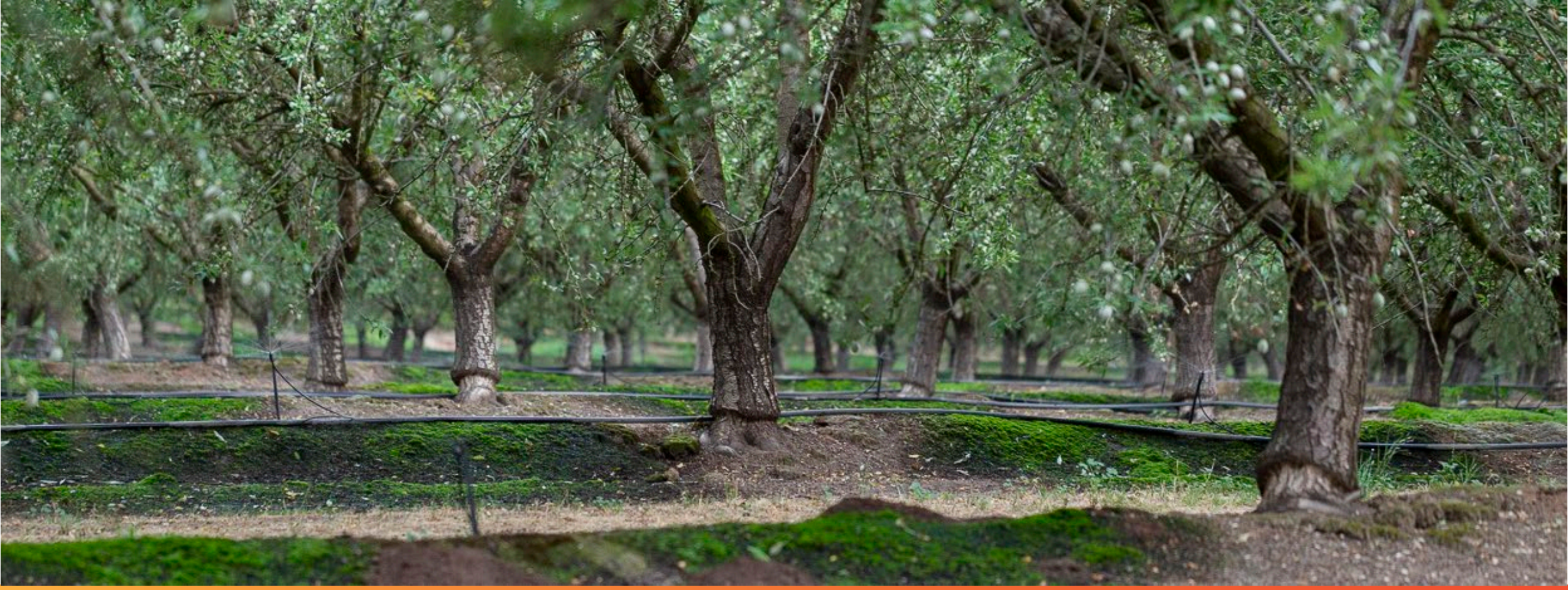

2018 | THE ALMOND CONFERENCE

ALMOND ORCHARD 2025: RESPONSIBLE PEST MANAGEMENT

ROOM 308-309 | DECEMBER 6, 2018

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growing ADVANTAGE
The Almond Conference

AGENDA

- **Christine Gemperle**, Gemperle Orchards, moderator
- **Brian Leahy**, DPR
- **Joel Kimmelshue**, Land IQ
- **Gabriele Ludwig**, Almond Board of California


Water
harvest dust
ALMOND
ORCHARD
2025 GOALS
pest management
zero waste


REDUCE THE AMOUNT OF **WATER** USED TO GROW A POUND OF ALMONDS BY **20%**
REDUCE **DUST** DURING ALMOND HARVEST BY **50%**
water
harvest dust
pest management
zero waste
ALMOND ORCHARD
2025 GOALS
Suterra
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

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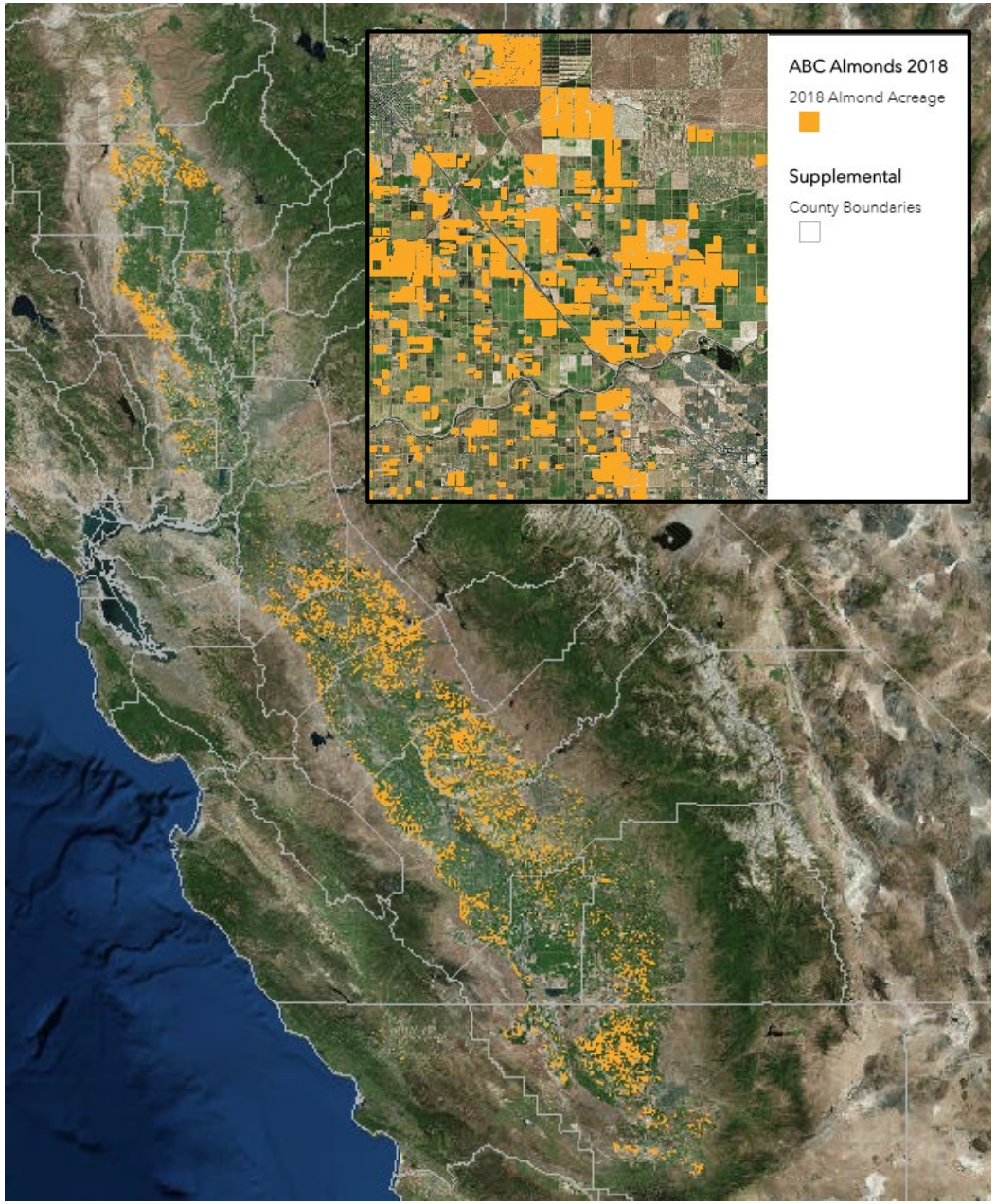
Cooperators and Resources

- 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



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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

2016	2018	2019	2020	2021
Initial Acreage 2016	**Initial Acreage 2018**	**Initial Acreage 2019**	**Initial Acreage 2020**	**Initial Acreage 2021**
Final Acreage 2014	**Final Acreage 2016**	**Final Acreage 2017 (TBD)**	**Final Acreage 2018**	**Final Acreage 2019**

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%.

2016 Acreage	Initial	Final	Difference	% Difference
Bearing	**981,813**	**982,364**	**551**	**0.06%**
Non-Bearing	**280,102**	**274,307**	**(5,795)**	**-2.07%**
Total	**1,261,915**	**1,256,671**	**(5,244)**	**-0.42%**

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-bearing acreage (1, 2, and 3 year old orchards) is estimated at 289,133

2018 Acreage	Initial
Bearing	1,088,657
Non-Bearing	289,133
Total	1,377,790

Acreage Results - Bearing

- USDA-NASS and Land IQ Acreage Comparisons

	2010	2012	2014	2016	2018
Land IQ	***810,386***	***885,575***	***938,441***	***982,364***	***1,088,657***
USDA-NASS	***770,000***	***820,000***	***870,000***	***940,000***	***1,070,000***
Difference	***40,386***	***65,575***	***68,441***	***42,364***	***18,657***
% Difference	***5.24%***	***8.00%***	***7.87%***	***4.51%***	***1.74%***

- 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

	2010	2012	2014	2016	2018
Land IQ	***124,568***	***118,595***	***189,505***	***274,307***	***289,133***
USDA-NASS[1]	***85,000***	***110,000***	***170,000***	***300,000***	***NA***
Difference	***39,568***	***8,595***	***19,505***	***-25,693***	
% Difference	***46.55%***	***7.81%***	***11.47%***	***-8.56%***	

- 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

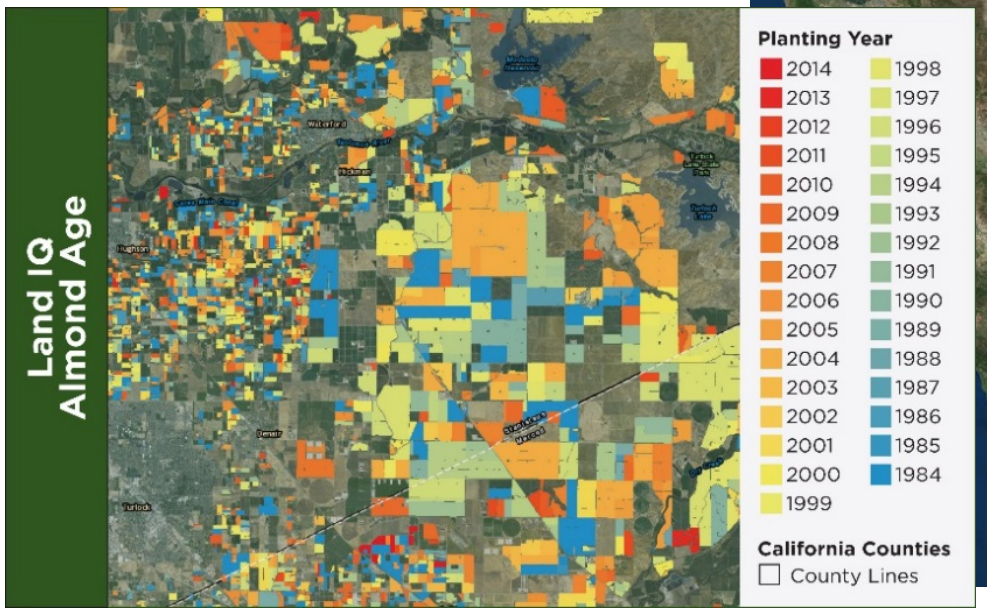
- USDA-NASS and Land IQ Acreage Comparisons

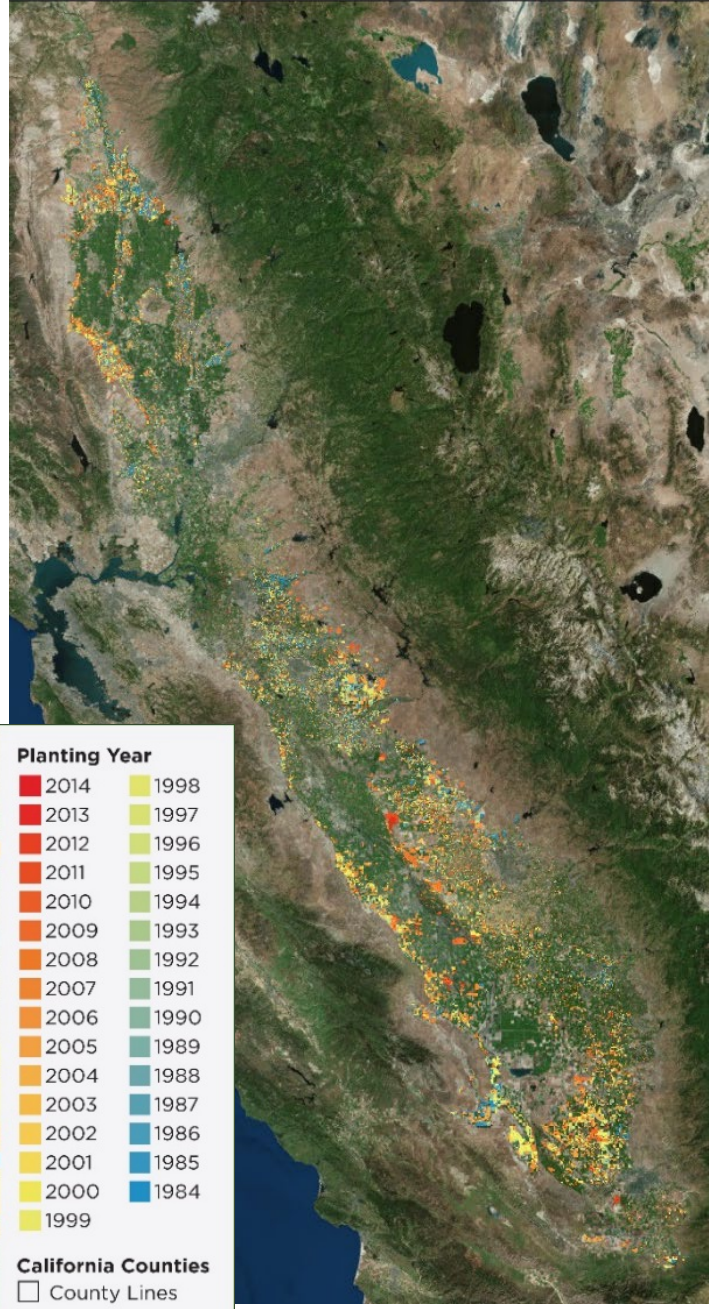
	2010	2012	2014	2016	2018
Land IQ	***934,954***	***1,004,170***	***1,127,946***	***1,256,671***	***1,377,790***
USDA-NASS[1]	***855,000***	***930,000***	***1,040,000***	***1,240,000***	***N/A***
Difference	***79,954***	***74,170***	***87,946***	***16,671***	***N/A***
% Difference	***9.35%***	***7.98%***	***8.46%***	***1.34%***	***N/A***

- 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





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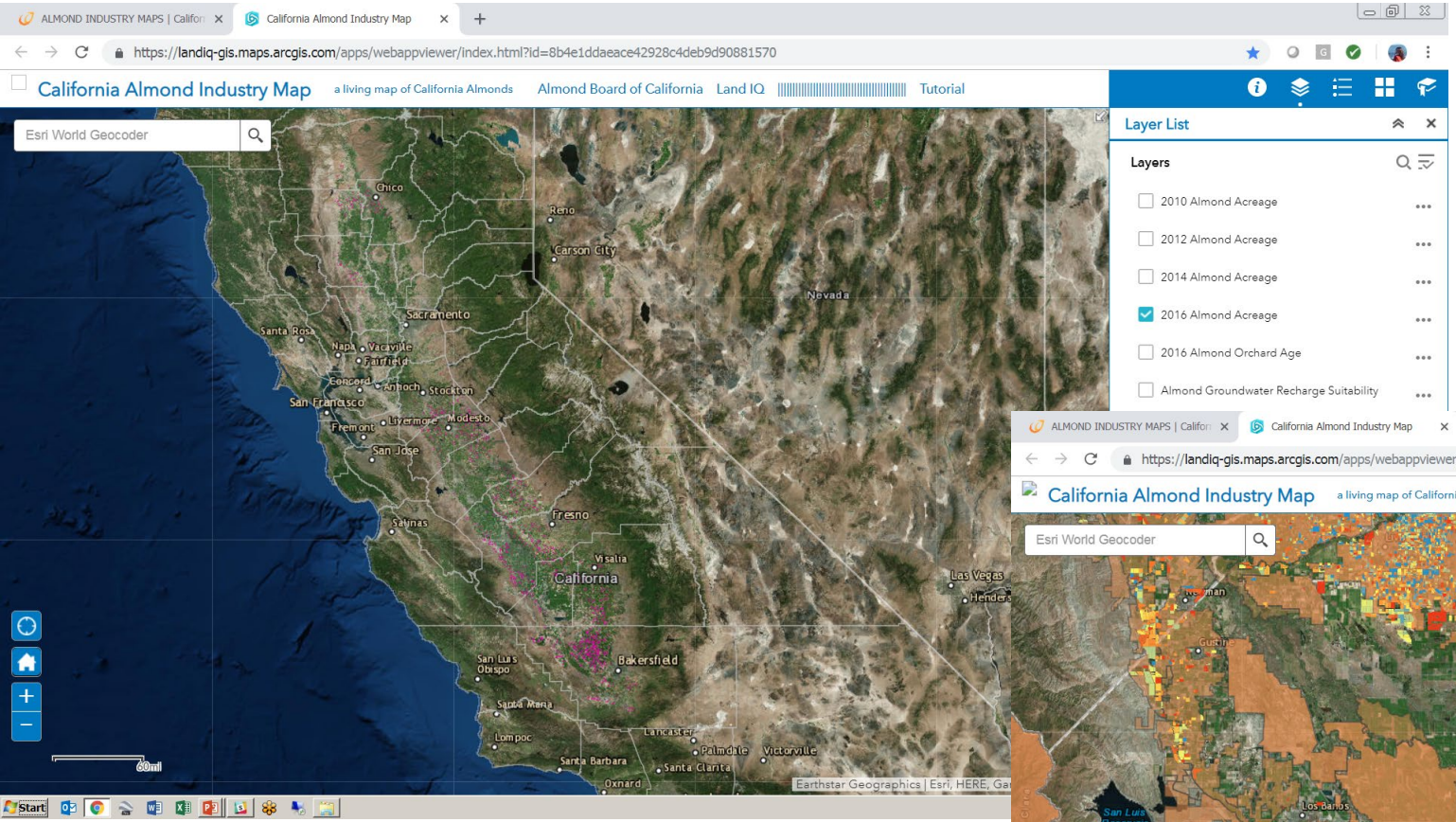
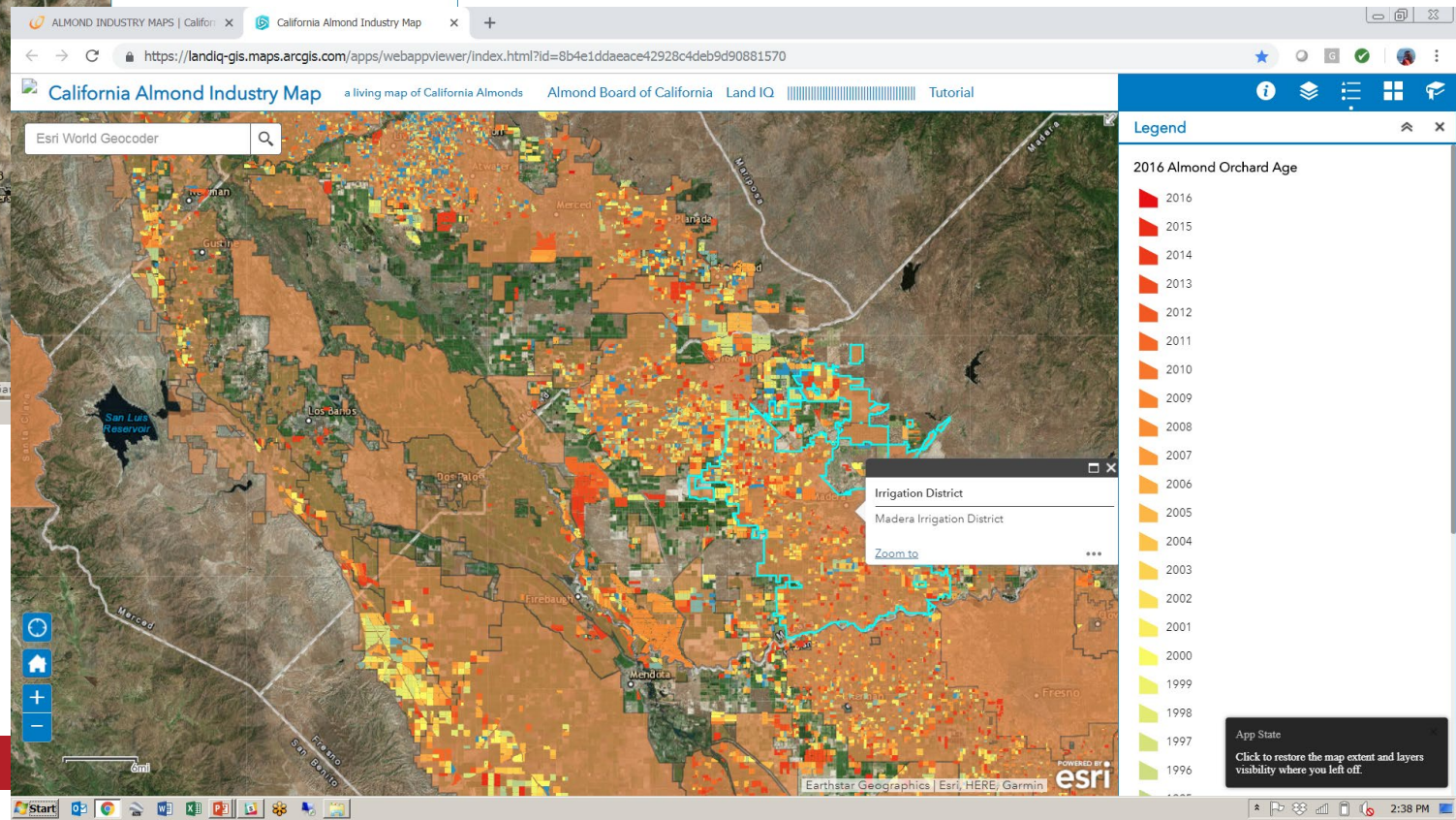
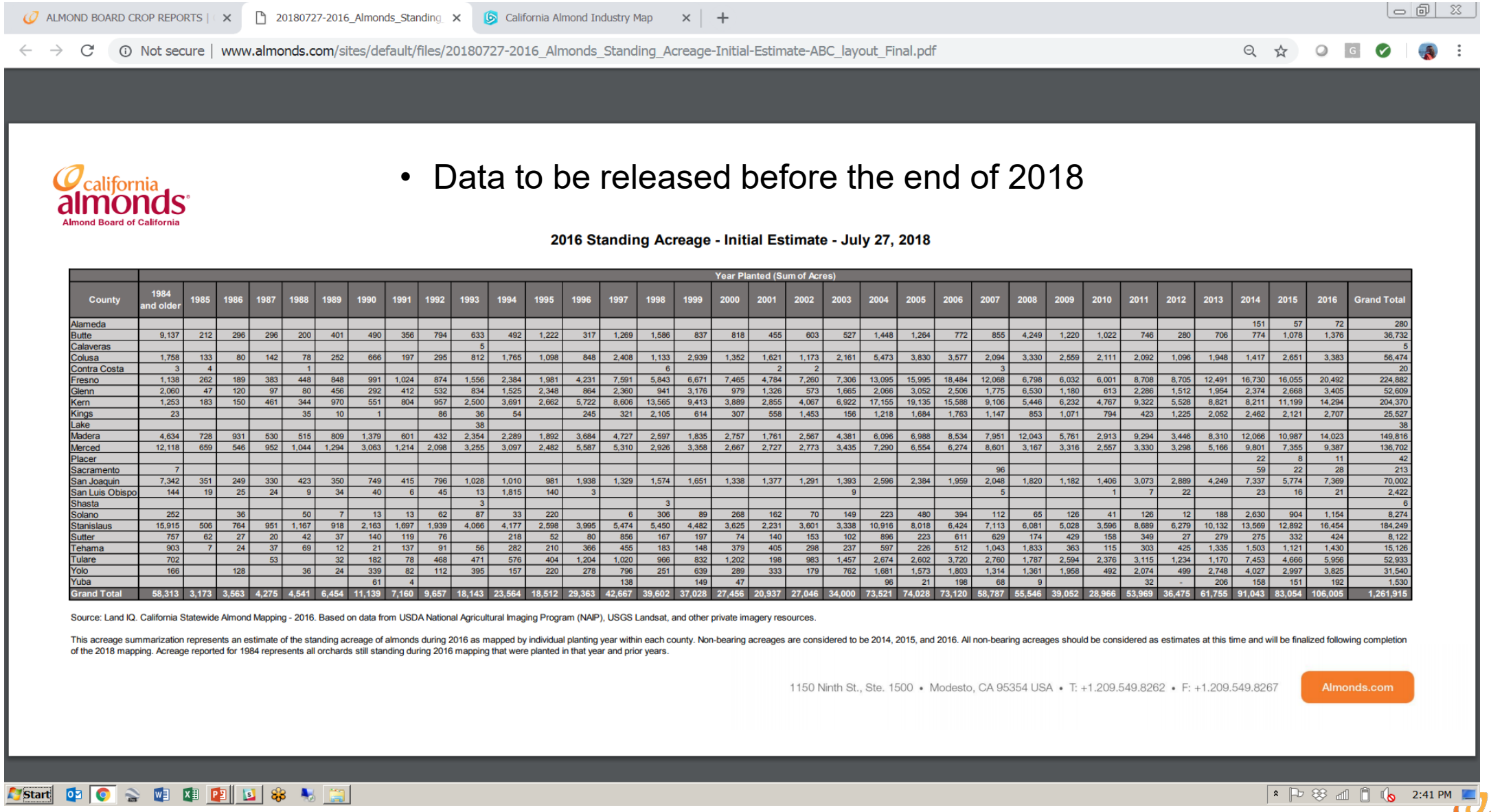
Spatial Information – ABC External Viewer: www.almonds.com/maps





- Viewable maps to be released before the end of 2018

Tabular Information: www.almonds.com/growers/resources/crop-forecasts



ALMOND BOARD CROP REPORTS | 20180727-2016_Almonds_Standing | California Almond Industry Map

Not secure | www.almonds.com/sites/default/files/20180727-2016_Almonds_Standing_Acreage-Initial-Estimate-ABC_layout_Final.pdf

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- Data to be released before the end of 2018

2016 Standing Acreage - Initial Estimate - July 27, 2018

	Year Planted (Sum of Acres)																																
County	1984 and older	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Grand Total
Alameda																															151	57	72	280
Butte	9,137	212	296	296	200	401	490	356	794	633	492	1,222	317	1,269	1,586	837	818	455	603	527	1,448	1,264	772	855	4,249	1,220	1,022	746	280	706	774	1,078	1,376	36,732
Calaveras										5																								5
Colusa	1,758	133	80	142	78	252	666	197	295	812	1,765	1,098	848	2,408	1,133	2,939	1,352	1,621	1,173	2,161	5,473	3,830	3,577	2,094	3,330	2,559	2,111	2,092	1,096	1,948	1,417	2,651	3,383	56,474
Contra Costa	3	4			1										6			2	2					3										20
Fresno	1,138	262	189	383	448	848	991	1,024	874	1,556	2,384	1,981	4,231	7,591	5,843	6,671	7,465	4,784	7,260	7,306	13,095	15,995	18,484	12,068	6,798	6,032	6,001	8,708	8,705	12,491	16,730	16,055	20,492	224,882
Glenn	2,060	47	120	97	80	456	292	412	532	834	1,525	2,348	864	2,360	941	3,176	979	1,326	573	1,665	2,066	3,052	2,506	1,775	6,530	1,180	613	2,286	1,512	1,954	2,374	2,668	3,405	52,609
Kern	1,253	183	150	461	344	970	551	804	957	2,500	3,691	2,662	5,722	8,606	13,565	9,413	3,889	2,855	4,067	6,922	17,155	19,135	15,588	9,106	5,446	6,232	4,767	9,322	5,528	8,821	8,211	11,199	14,294	204,370
Kings	23				35	10	1		86	36	54		245	321	2,105	614	307	558	1,453	156	1,218	1,684	1,763	1,147	853	1,071	794	423	1,225	2,052	2,462	2,121	2,707	25,527
Lake										38																								38
Madera	4,634	728	931	530	515	809	1,379	601	432	2,354	2,289	1,892	3,684	4,727	2,597	1,835	2,757	1,761	2,567	4,381	6,096	6,988	8,534	7,951	12,043	5,761	2,913	9,294	3,446	8,310	12,066	10,987	14,023	149,816
Merced	12,118	659	546	952	1,044	1,294	3,063	1,214	2,098	3,255	3,097	2,482	5,587	5,310	2,926	3,358	2,667	2,727	2,773	3,435	7,290	6,554	6,274	8,601	3,167	3,316	2,557	3,330	3,298	5,166	9,801	7,355	9,387	136,702
Placer																															22	8	11	42
Sacramento	7																							96							59	22	28	213
San Joaquin	7,342	351	249	330	423	350	749	415	796	1,028	1,010	981	1,938	1,329	1,574	1,651	1,338	1,377	1,291	1,393	2,596	2,384	1,959	2,048	1,820	1,182	1,406	3,073	2,889	4,249	7,337	5,774	7,369	70,002
San Luis Obispo	144	19	25	24	9	34	40	6	45	13	1,815	140	3							9				5			1	7	22		23	16	21	2,422
Shasta										3					3																			6
Solano	252		36		50	7	13	13	62	87	33	220		6	306	89	268	162	70	149	223	480	394	112	65	126	41	126	12	188	2,630	904	1,154	8,274
Stanislaus	15,915	506	764	951	1,167	918	2,163	1,697	1,939	4,066	4,177	2,598	3,995	5,474	5,450	4,482	3,625	2,231	3,601	3,338	10,916	8,018	6,424	7,113	6,081	5,028	3,596	8,689	6,279	10,132	13,569	12,892	16,454	184,249
Sutter	757	62	27	20	42	37	140	119	76		218	52	80	856	167	197	74	140	153	102	896	223	611	629	174	429	158	349	27	279	275	332	424	8,122
Tehama	903	7	24	37	69	12	21	137	91	56	282	210	366	455	183	148	379	405	298	237	597	226	512	1,043	1,833	363	115	303	425	1,335	1,503	1,121	1,430	15,126
Tulare	702			53		32	182	78	468	471	576	404	1,204	1,020	966	832	1,202	198	983	1,457	2,674	2,602	3,720	2,760	1,787	2,594	2,376	3,115	1,234	1,170	7,453	4,666	5,956	52,933
Yolo	166		128		36	24	339	82	112	395	157	220	278	796	251	639	289	333	179	762	1,681	1,573	1,803	1,314	1,361	1,958	492	2,074	499	2,748	4,027	2,997	3,825	31,540
Yuba							61	4						138		149	47				96	21	198	68	9			32	-	206	158	151	192	1,530
Grand Total	58,313	3,173	3,563	4,275	4,541	6,454	11,139	7,160	9,657	18,143	23,564	18,512	29,363	42,667	39,602	37,028	27,456	20,937	27,046	34,000	73,521	74,028	73,120	58,787	55,546	39,052	28,966	53,969	36,475	61,755	91,043	83,054	106,005	1,261,915

Source: Land IQ. California Statewide Almond Mapping - 2016. Based on data from USDA National Agricultural Imaging Program (NAIP), USGS Landsat, and other private imagery resources.

This acreage summarization represents an estimate of the standing acreage of almonds during 2016 as mapped by individual planting year within each county. Non-bearing acreages are considered to be 2014, 2015, and 2016. All non-bearing acreages should be considered as estimates at this time and will be finalized following completion of the 2018 mapping. Acreage reported for 1984 represents all orchards still standing during 2016 mapping that were planted in that year and prior years.

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Almonds.com

Start 2:41 PM

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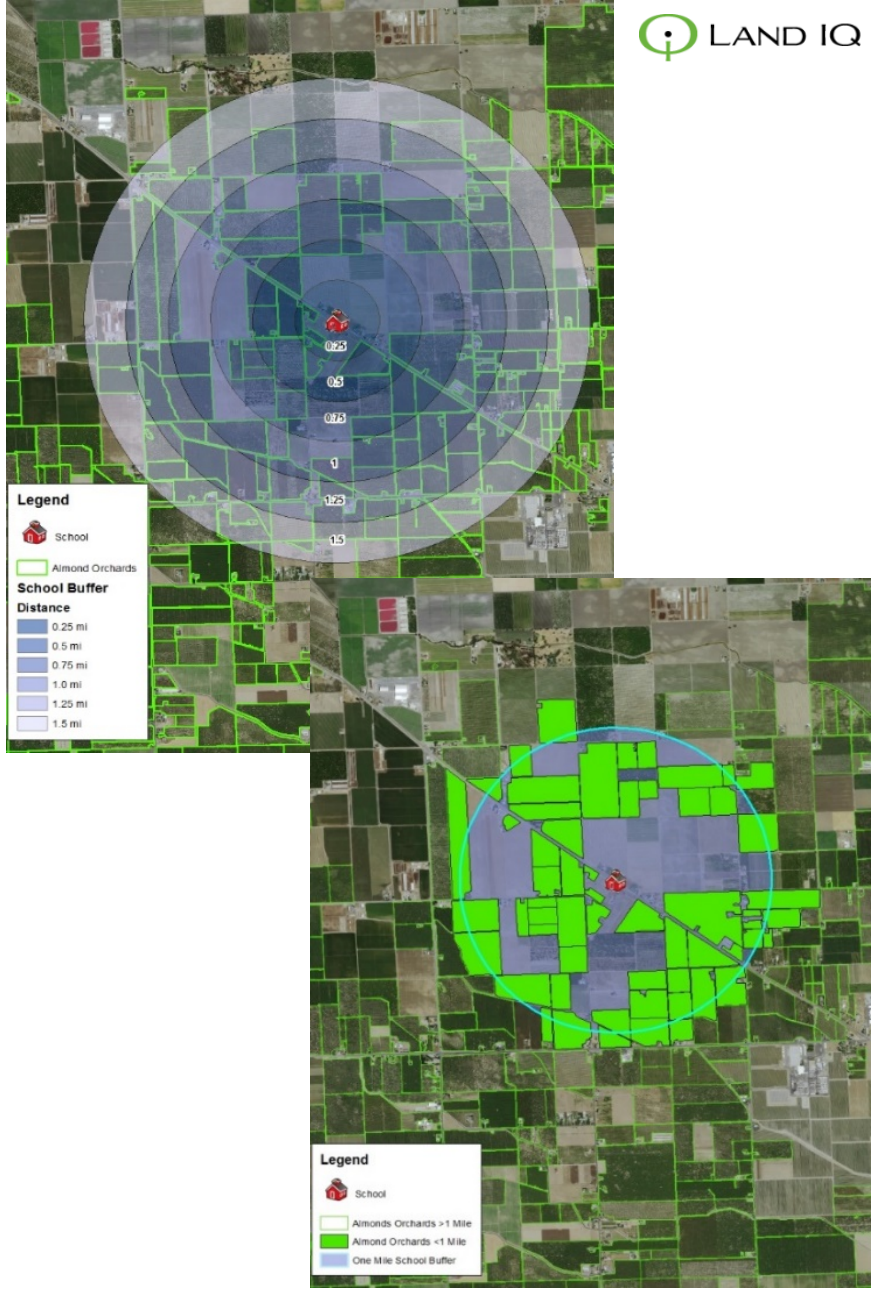
Applications of Almond Mapping
School Proximity Analysis

- 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.

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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

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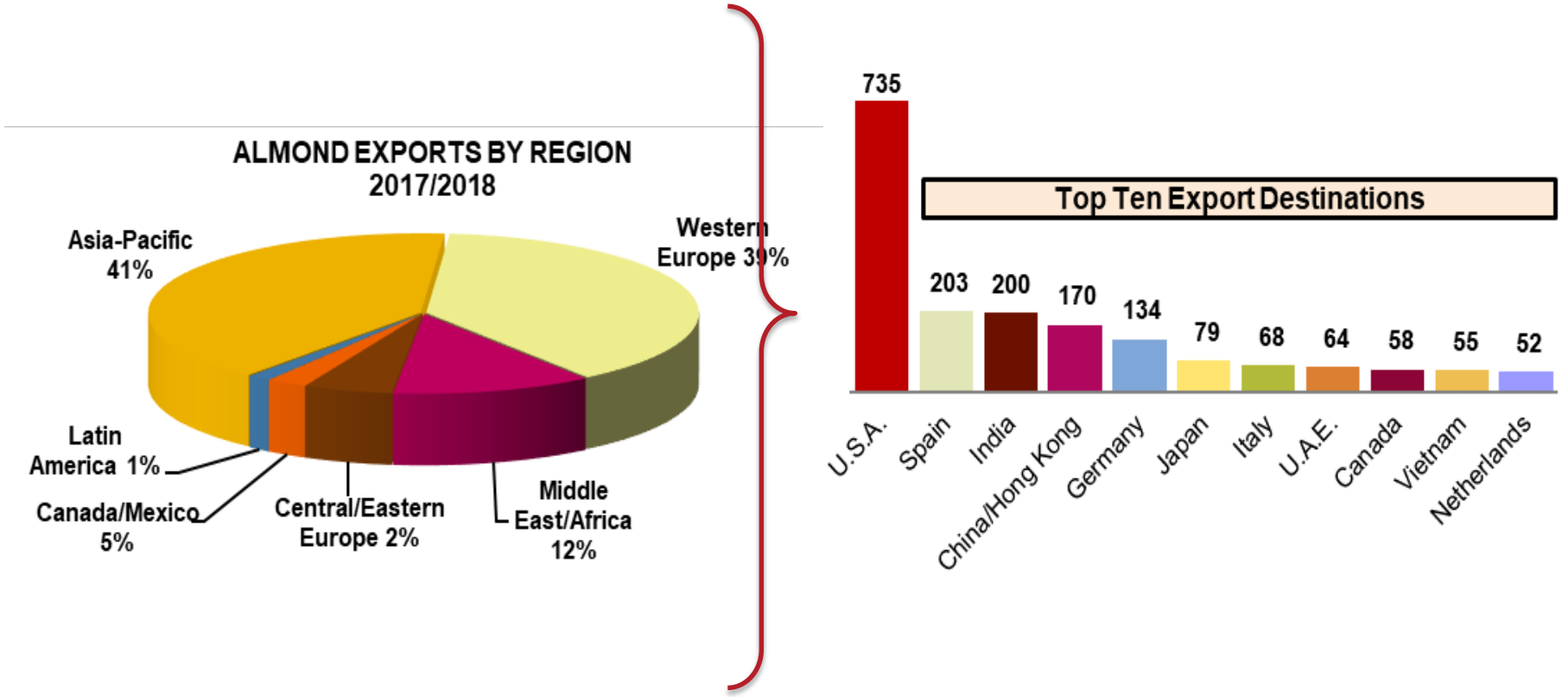
Almonds are Highly Exported:
2017/18 California Almond Shipment Overview



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

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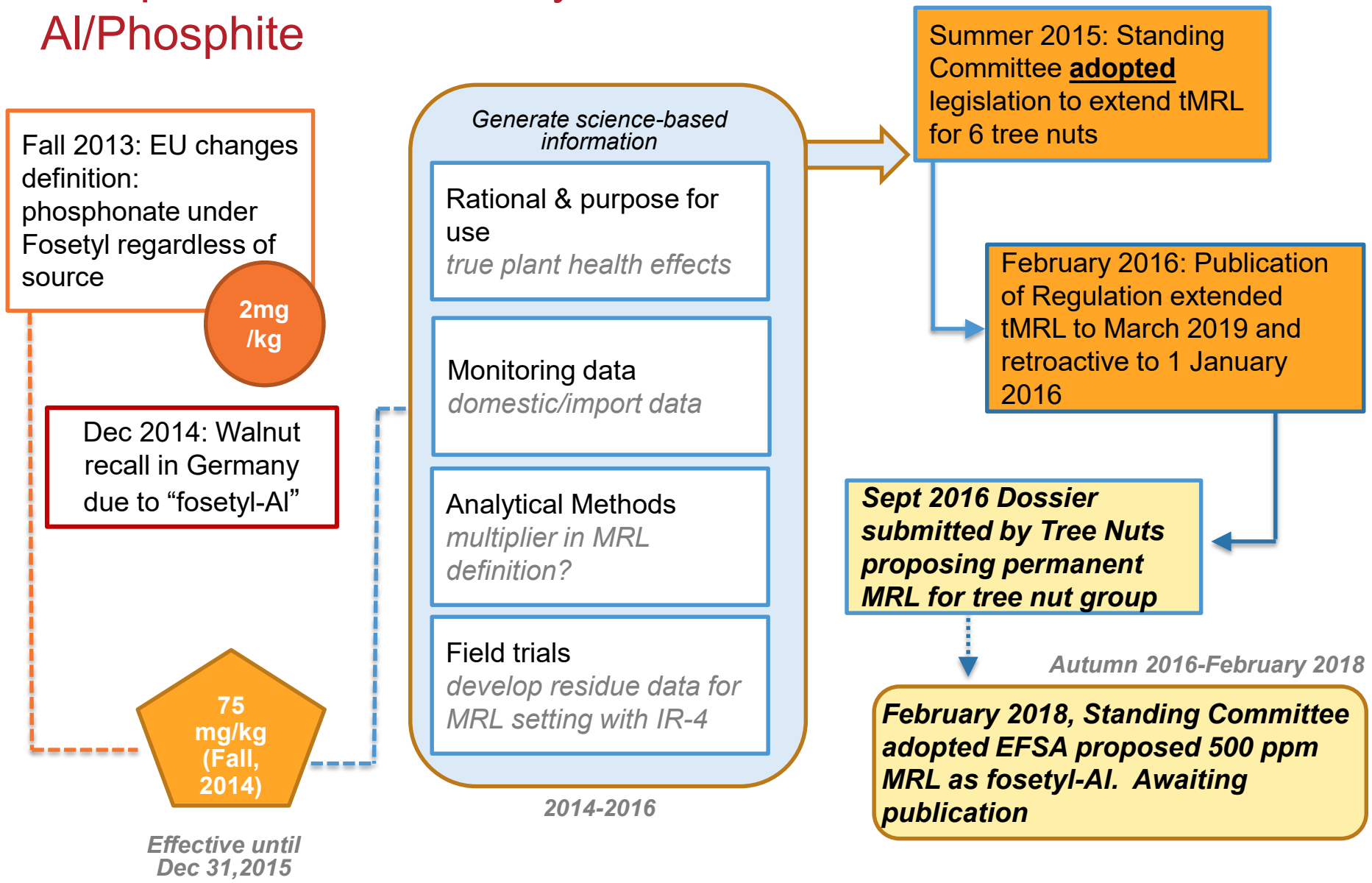
European Union – Fosetyl-Al/Phosphite



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)

Fungicides for use for Blossom Brown Rot (Monilinia) in Almonds per UC-IPM website	*Resistance Category (FRAC)*	*2016 CA acres treated*	*US MLR (ppm)*	*EU MRL (ppm)*
propiconazole	3	345,737	0.1	0.01
fenbuconazole	3	19,419	0.05	0.05
difenoconazole	3	219,774	0.03	0.05
metconazole	3	431,378	0.04	0.05
tebuconazole	3	121,334	0.05	0.05
myclobutanil	3	3,563	0.01	0.05
difenoconazole/cyprodinil	3/9	219,774/ 199,975		
azoxystrobin	11	381,705 / 345,737	0.02	0.01
azoxystrobin/propiconazole	11/3	381,705		
pyraclostrobin/boscalid	11/7	420,224 /190,130	0.04 /0.7	0.02 /0.05
pyraclostrobin/fluxapyroxad	11/7	420,224 / 230,095	0.04 /0.06	0.02 /0.04
trifloxystrobin	11	308,378	0.04	0.02
fluopyram/trifloxystrobin	7/11	380,521 / 308,377	0.05	0.05
fluopyram/tebuconazole	7/3	380,521 / 431,378	0.05/0.05	0.05/0.05
thiophanate methyl	1	48,490	0.1	0.2
iprodione	2	388,110	0.3	0.2
pyramethanil	9	104,172	0.2	0.2
cyprodinil	9	199,975	0.02	0.02
captan	M4	24,386	0.25	0.07
fenhexamid	17	0	0.02	0.02

* 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 AIs/ 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.

*https://www.coleacp.org/en/system/files/file_fields/2016/05/11/eng-bd2520pip2520position2520paper2520potential2520impact2520proposed2520changes2520to2520eu2520pesticide-0.pdf

Fungicides for use for Blossom Brown Rot (Monilinia) in Almonds per UC-IPM website	*Resistance Category (FRAC)*	*2016 CA acres treated*	*US MLR (ppm)*	*EU MRL (ppm)*
~~propiconazole~~	~~3~~	~~345,737~~	~~0.1~~	~~0.01~~
~~febuconazole~~	~~3~~	~~19,419~~	~~0.05~~	~~0.05~~
~~difenoconazole~~	~~3~~	~~219,774~~	~~0.03~~	~~0.05~~
~~metconazole~~	~~3~~	~~431,378~~	~~0.04~~	~~0.05~~
~~tebuconazole~~	~~3~~	~~121,334~~	~~0.05~~	~~0.05~~
~~myclobutanil~~	~~3~~	~~3,563~~	~~0.01~~	~~0.05~~
~~difenoconazole/cyprodinil~~	~~3/9~~	~~219,774/ 199,975~~		
azoxystrobin	11	381,705 / 345,737	0.02	0.01
~~azoxystrobin/propiconazole~~	~~11/3~~	~~381,705~~		
pyraclostrobin/boscalid	11/7	420,224 /190,130	0.04 /0.7	0.02 /0.05
pyraclostrobin/fluxapyroxad	11/7	420,224 / 230,095	0.04 /0.06	0.02 /0.04
trifloxystrobin	11	308,378	0.04	0.02
fluopyram/trifloxystrobin	7/11	380,521 / 308,377	0.05/0.04	0.05/0.02
~~fluopyram/tebuconazole~~	~~7/3~~	~~380,521 / 431,378~~	~~0.05/0.05~~	~~0.05/0.05~~
~~thiophanate methyl (if as carbendazim)~~	~~1~~	~~48,490~~	~~0.1~~	~~0.2~~
~~iprodione~~	~~2~~	~~388,110~~	~~0.3~~	~~0.2~~
pyramethanil	9	104,172	0.2	0.2
~~cyprodinil~~	~~9~~	~~199,975~~	~~0.02~~	~~0.02~~
captan	M4	24,386	0.25	0.07
fenhexamid	17	0	0.02	0.02

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!

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