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## **Almond and Aflatoxin: Investigating the Extent of Impact on California Exports**

**Mina Hejazi and Jeta Rudi Polloshka**

*Selected Paper prepared for presentation at the International Agricultural Trade Research Consortium's (IATRC's) 2019 Annual Meeting: Recent Advances in Applied General Equilibrium Modeling: Relevance and Application to Agricultural Trade Analysis, December 8-10, 2019, Washington, DC.*

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# Almond and Aflatoxin

Investigating the Extent of Impact on California Exports

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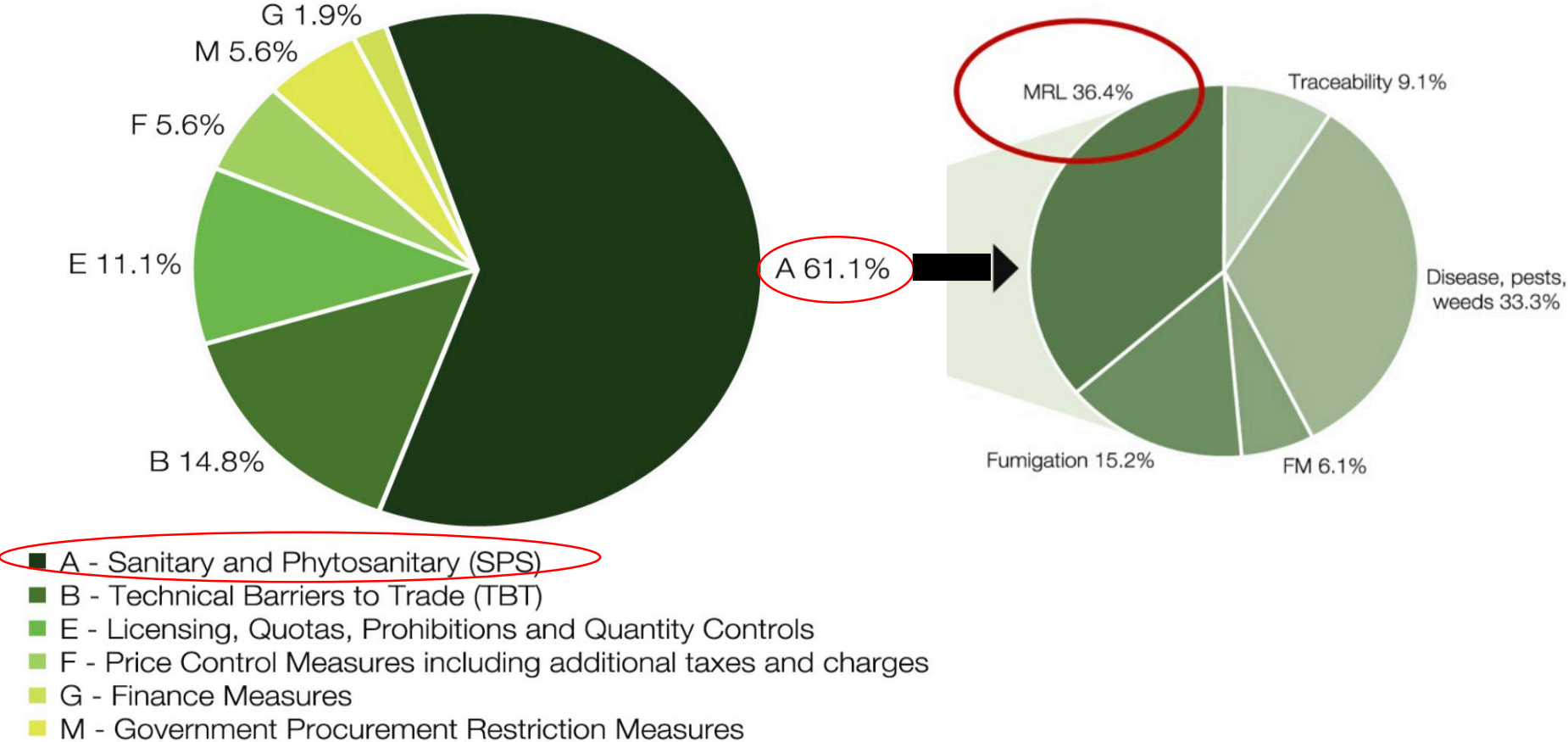
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IATRC, Washington DC, December 8-10, 2019

# Outline

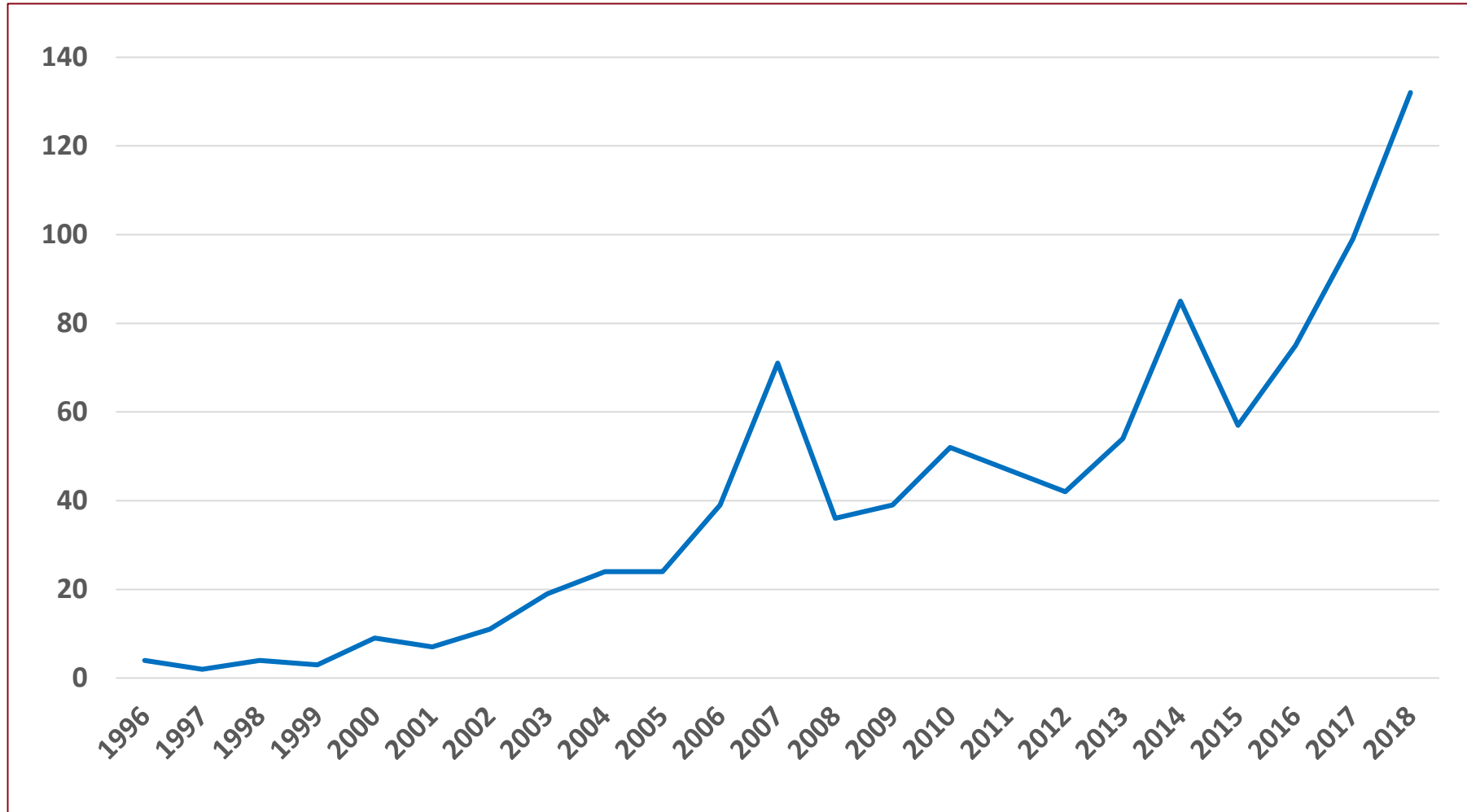
- Motivation – pesticides' maximum residue limits (MRLs) for fruits and vegetables
- Proposal to submit for CSU, Agricultural Research Institute
  - Background on Almond, California and Aflatoxin
  - Trade policy and regulations on aflatoxin
    - Variation in regulations across countries
  - Industry concerns and challenges
    - Losing money (the right to destroy the shipment)
  - Research planning

# Non-Tariff Barriers to Trade (NTBs): Results by source of NTB



Source: Canada Grain Council, 2019

# WTO SPS MRL Notifications – Fruits and Vegetables

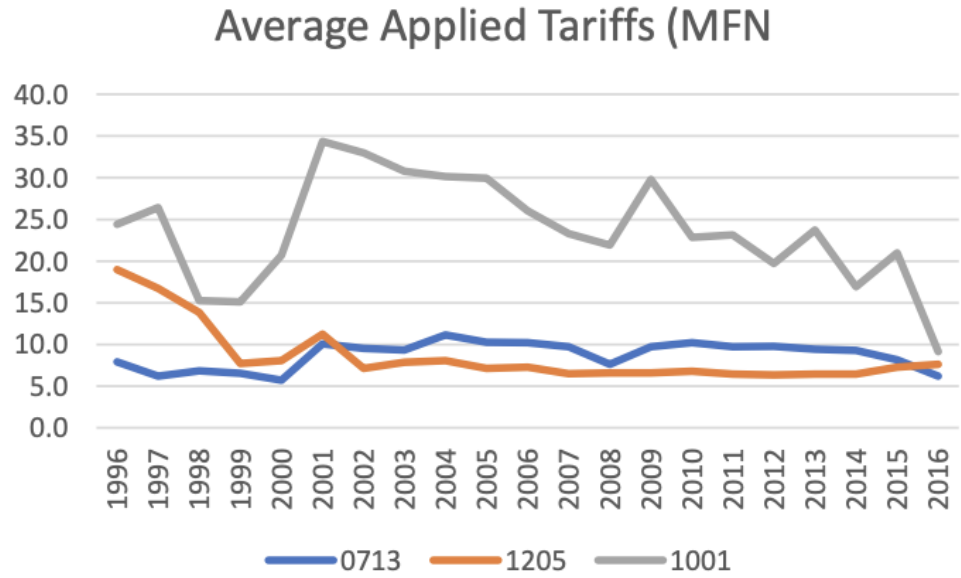


Source: WTO SPS MRL Notifications

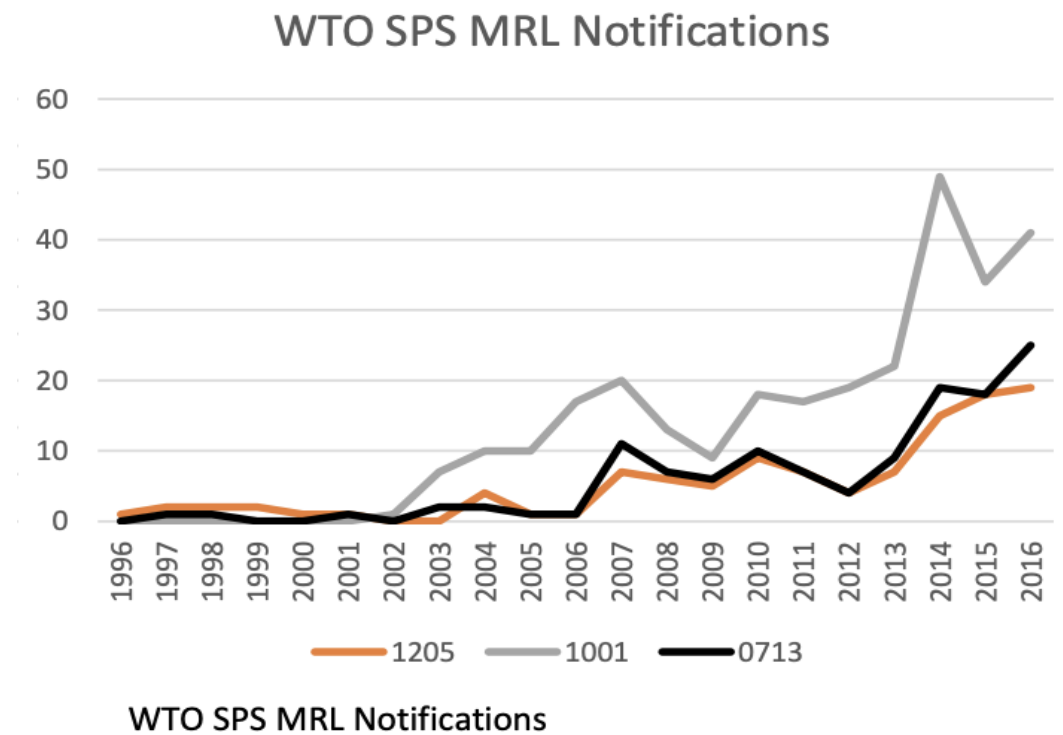
# MRLs and protectionism?

“In the 1980s and 1990s, we had never heard of MRLs. In the last five years MRLs are probably the first thing we consider in a pest management decision.” Jehle, director of technical services for Sunview.

Here are roughly 200 countries in the world and to those who manufacture chemicals and export agricultural products, it must seem like there are 200 sets of rules.



Average % AV Applied MFN Tariff  
 Average of China, Japan, United States, India, Mexico, Pakistan, UAE, EU, Turkey, Colombia  
 Sourced from WTO tariff download facility  
 Oilseeds, Cereals and Pulses and Special Crops  
 Source: Canada Grain Council, 2019



# Almond and Aflatoxin

Investigating the Extent of Impact on California Exports



# Almond and California

- Almonds are the top US specialty crop in export value
- Top California crop in export value
- 100% of U.S. production
- 80% of worldwide production and global consumers' demand
- Shipments 66% export and 34% domestic
- \$5.6 billion export (2017/18)

# California Almond Shipment Overview 2017/2018

## Top Global Destinations crop year 2017/18 | million pounds



Source: Almond board of California, 2018



# Food Safety Regulations and Aflatoxin

- Food safety regulations become increasingly important as trade instruments.
- The domestic sanitary regulations stringent than international standards may raise question on protectionist exercise of regulations in agricultural trade.
- Aflatoxin regulations are primarily important for nuts trade (FAO, 2004).
- Majority of the border rejections 94% for nut products in EU is due to mycotoxins versus 14% in US between 2002 and 2008 (Henson and Olale, 2010)
- Aflatoxins are a type of mycotoxin

# Aflatoxin

- Aflatoxins are naturally occurring chemicals produced by certain molds, mainly *Aspergillus flavus* and *A. parasiticus*.
- The main health concern of aflatoxins is their potential carcinogenicity.
- Chronic exposure to aflatoxins can increase the risk of developing liver cancer.
- Aflatoxin-producing molds are common in nature, affecting a number of crops especially nut products.
- **Favorable conditions for mold growth include high moisture content and high temperatures.**

# Preventing Aflatoxins

- The almond industry has programs and procedures in place to minimize aflatoxins at every stage of production — not just in response to sampling, testing and processing, but also focusing on the orchard environment, where aflatoxin contamination begins and where it must be addressed.

# Aflatoxins and Market Ramifications

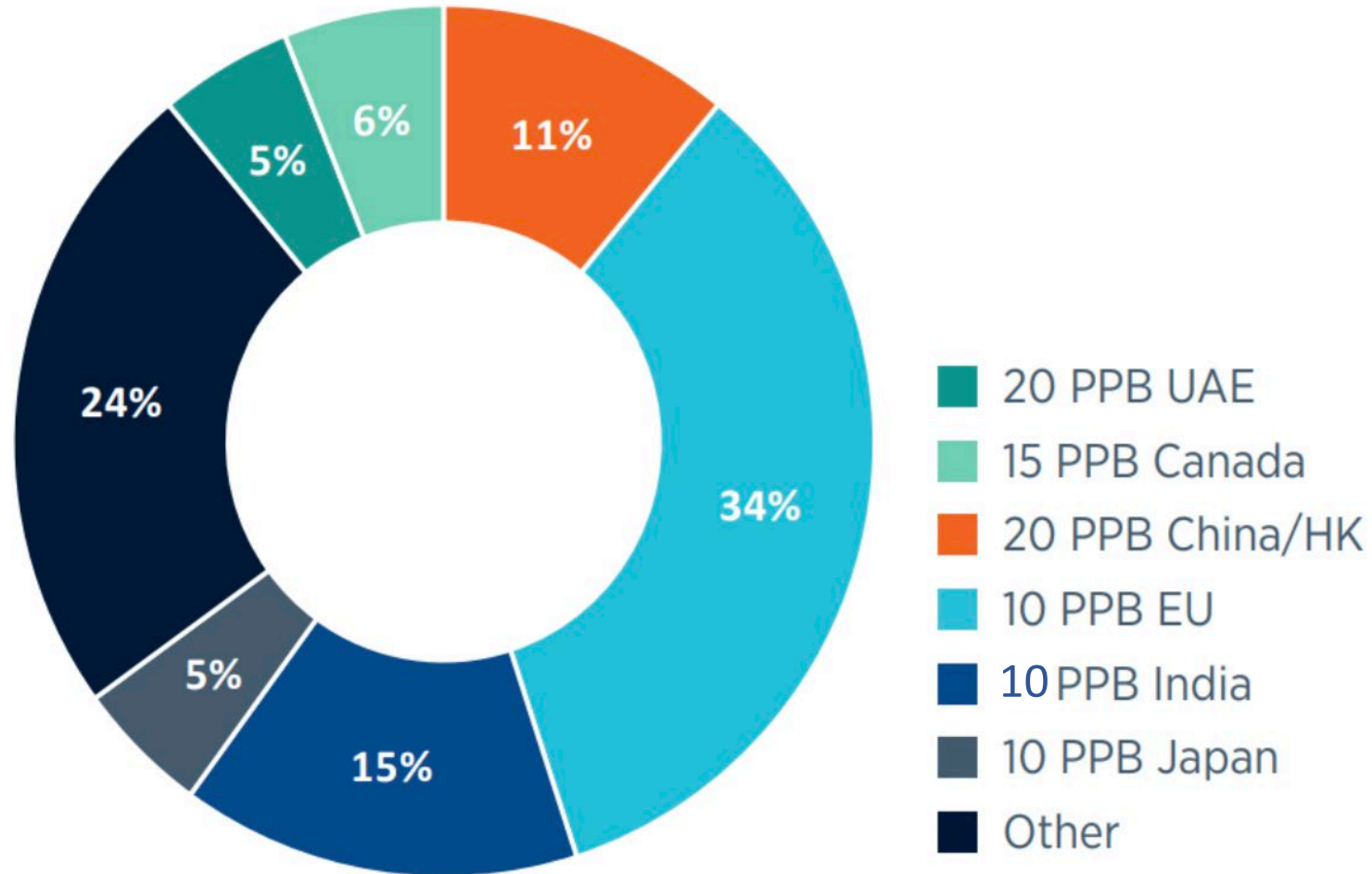
- Because they are a carcinogen, tolerances for aflatoxins have been established by certain countries to reduce risk of exposure
- When almonds are tested for aflatoxins and are found to have levels above the allowable limits by country, the consignment will be rejected, with significant monetary losses to the grower and handler
- Maximum Residue Limits

# Worldwide Aflatoxin Standards for Almond (Ready to eat)

Country	MRL (PPB)
EU 27 (Spain, Germany, Italy & Netherland ...)	10
India	10
China/Hong Kong	20
United Arab Emirates	20
Japan	10
Canada	15
Vietnam	10
International Standards (Codex)	15
United States	20 (industry standard 15)

Variation in regulations and across countries

# MRLs (ppb) for Top Importers by % of California Almond

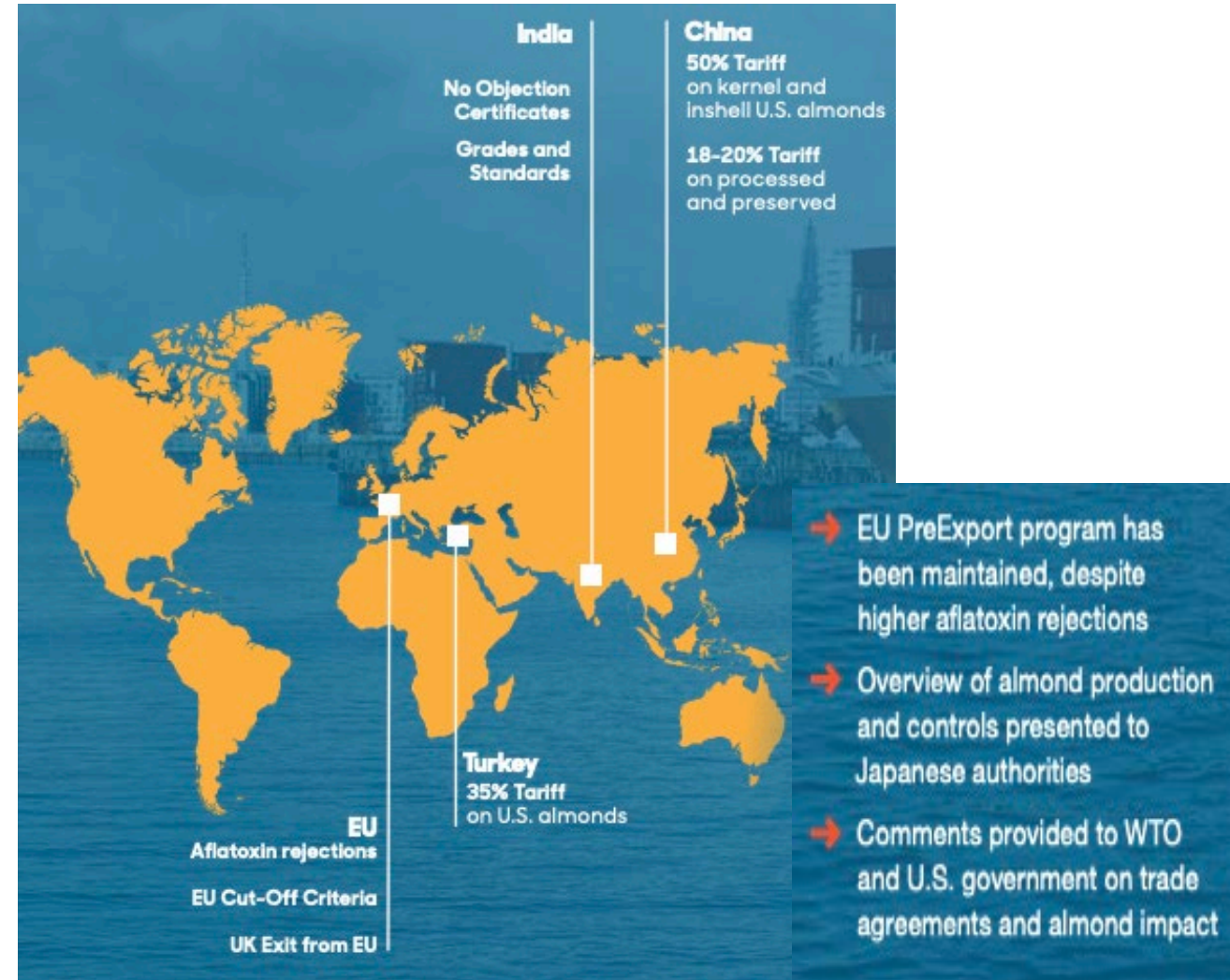




# More complex trade environment over the past few years

- SPS and TBT are the real concern
  - 1- more complicated to prove
  - 2- harder to resolve

Aflatoxin is one of them



## Major challenge: Almond and MRL for Aflatoxin

- One major concern is even if California almond growers and exporters follow the importing country's MRL on Aflatoxin, there will be variation on the test results of MRL on Aflatoxin while testing the same package at different times at the port of entry.
- If the results of those test indicate higher dose on Aflatoxin, the product will get rejected at the port of entry while there was no problem on the test results in the United States.

# European Union

- EU is one of the largest markets for California Almonds
- EU has one of the lowest allowable limits for aflatoxin contamination on almonds, currently 10 ppb
- Increased rejections of California Almond consignments led to additional import monitoring in the EU

# Industry concerns and challenges

## Meridian Growers

- lab certified – still re-testing (10, 15 or 20%)
- if MRL above the allowable limits, by the time all the controls are done in the US, it costs them a lot of money and time
- majority of cost on suppliers
- the EU can do one of three things:
  1. destroy the product
  2. return the product to the US
  3. allow the grower to ship it elsewhere from EU (without returning it to the US), e.g. to North Africa or Middle East.

# Research questions

- Explore the relationship between Aflatoxin limits and trade
  - While California supplies 80% of worldwide consumers' demand, how much leverage California's almond has as the number one producer and exporter?
- Examine compliance costs by producers and explore opportunities to pass the increased cost of compliance, to the end consumers
  - To be more specific, estimate the elasticity of demand for California almonds, in various key importing regions of the world

# Methodology

- Using trade models, what is the economic impact of MRL on Aflatoxin for California almond exports
- Using consumer demand models, assess opportunities for cost pass-through by exploring the demand elasticity for almonds



**Research Report  
CAT-2018-06**



**Center for  
Agricultural  
Trade**

**Hidden Trade Costs? Maximum Residue Limits  
and US Exports of Fresh Fruits and Vegetables**

# MRLs data – Grapes

Apple/chemical	MRL parts per million (PPM)				
	U.S.	EU	Japan	Canada	CODEX Standard
1. 2,4-D	0.05	0.05	0.5	---	0.1
2. Abamectin	0.02	0.01	---	0.02	---
3. Captan	25	0.02	5	5	25
4. Dicloran	10	0.1	7	10	7
5. Methomyl	5	0.02	5	4	0.3
...					
134. Ziram	7	0.1	5	7	5
Total number of established MRLs	134	118	114	73	71

EU has 53% MRLs more stringent than the U.S.

Japan has 24% MRLs more stringent than the U.S.

Canada has 25% MRLs more stringent than the U.S.



# The Bilateral Stringency Index (BSI)

$$BSI_{odck} = \left( \frac{1}{N_{ck}} \right) \sum_{p \in N_{ck}} \exp \left( \frac{MRL_{opk} - MRL_{dpk}}{MRL_{opk}} \right)$$

- ▶ Origin country (*o*), destination country (*d*), class of chemicals (*c*), and commodity (*k*)
  - ▶ Class of chemicals (herbicides- fungicides- insecticides- other)
  - ▶  $N_{ck}$ : number of chemicals (*p*) used in production in class *c* for commodity *k*
  - ▶  $MRL_{opk}$ : maximum residue limit for the  $p^{\text{th}}$  chemical class *c* for commodity *k* in region *o*
  - ▶  $MRL_{dpk}$ : maximum residue limit for the  $p^{\text{th}}$  chemical class *c* for commodity *k* in region *d*
- ▶  $0 < BSI < 1$ : *d* country is less stringent than *o* country
  - ▶  $BSI = 1$ : equivalent MRL policy situation for both countries
  - ▶  $e^1 = 2.72 \geq BSI > 1$ : *d* country more stringent than *o* country

## Results: Stringency Indices for Top U.S. Exports (Trade Weighted -2014)

Commodity	BSI TPP Countries	Rank
Apples	1.07	19
Grapes	1.10	26
Strawberries	1.16	36
Leaf lettuce	1.02	13
Oranges	0.92	7
Cabbage	1.23	47
Onions	1.21	45
Potatoes	1.18	41
Raspberries/Blackberries	1.16	37
Tomatoes	1.04	16

Commodity	BSI EU	Rank
Grapefruit	1.49	15
Apples	1.42	6
Grapes	1.26	2
Mandarins	1.40	5
Strawberries	1.66	27
Cranberries/blueberries	1.69	39
Raspberries/blackberries	1.68	30
Asparagus	1.67	28
Mushrooms/Truffles	1.17	1
Onions	1.84	41

## Model - PPML

$$X_{odk} = \exp \left[ \pi_o + \pi_d + \pi_k + \sum_c \theta_c BSI_{codk} + \delta_1 \ln Dist_{od} + \delta_2 RTA_{od} + \sum_c \theta_{c_{US-EU}} BSI_{codk} I_{US-EU} + \sum_c \theta_{c_{US-TPP}} BSI_{codk} I_{US-TPP} \right] \varepsilon_{odk}$$

- ▶  $X_{odk}$  = Export value of bilateral fruit and vegetable trade
- ▶  $\pi_o$ ,  $\pi_d$  and  $\pi_k$  = exporter, importer and commodity fixed effects
- ▶  $BSI_{codk}$  = Bilateral Stringency Index
- ▶  $\ln Dist_{od}$  = Geographical distance between trading partner
- ▶  $RTA_{od}$  = Regional Trade Agreements between trading partner
- ▶  $I_{US-EU}$  and  $I_{US-TPP}$  = indicator variables
- ▶  $\varepsilon_{odk}$  = the multiplicative error term

# Econometric Result

Variable	1. Overall	2. Chemical Types	3. US-EU, US-TPP
BSI	-0.44***		-0.41***
At disaggregated level: BSI effect to vary over different classes of chemicals			
BSI-Insecticides		-0.34***	
BSI-Herbicides		-0.34***	
BSI-Fungicides		-0.68***	
Introducing individual controls for U.S. exports to the EU & U.S. exports TPP countries			
US → EU			-1.58***
US → TPP			0.39***

- ▶ Stricter BSIs by 0.1
  - ▶ reduces FFV exports by 4.4%
  - ▶ reduces U.S. export of FFV to EU members by 15.8%
  - ▶ increases U.S. export of FFV to TPP members by 3.9%