

Pesticides in Citrus Industry

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September 22, 2023

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Topics



0 1 Pesticide Use in Citrus Crops

0 2 Reality of Media Influence

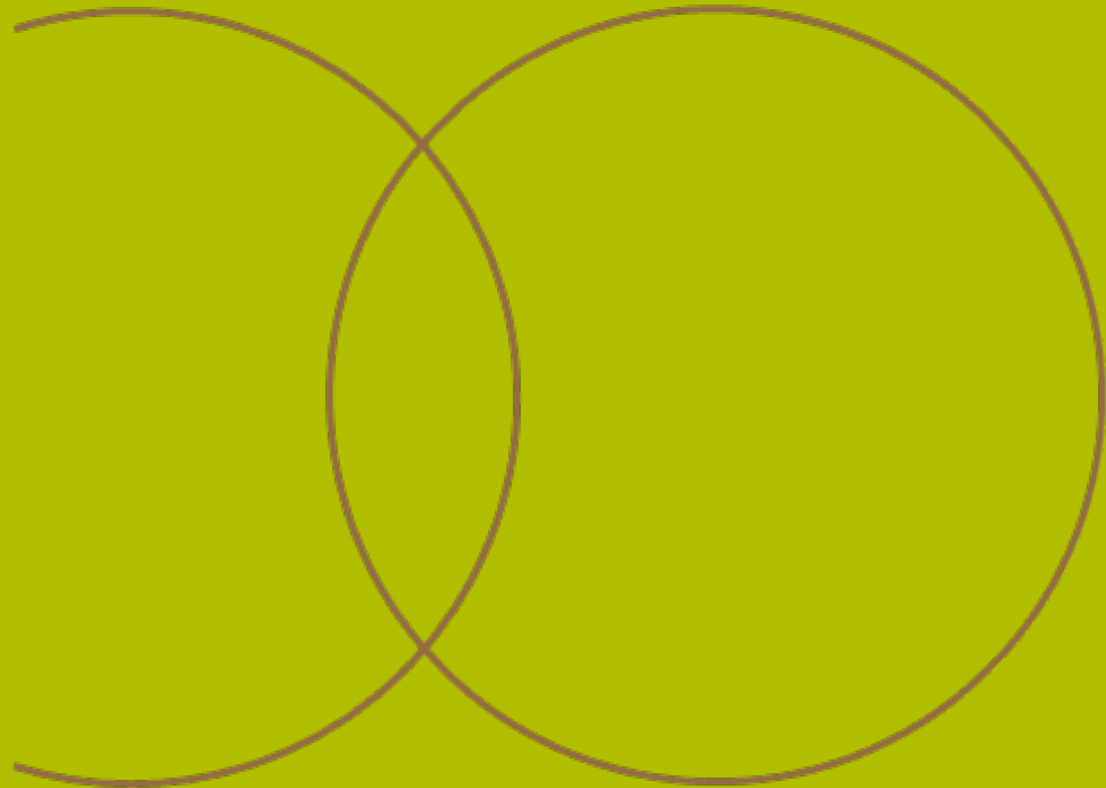
0 3 MRL Regulations & Testing

0 4 Concentration/Processing

0 5 Industry Issues & Possible Solutions

01

Pesticides in Citrus Crops



Need for Pesticides

AN EXPECTED 60% INCREASE IN DEMAND FOR FOOD BY 2050

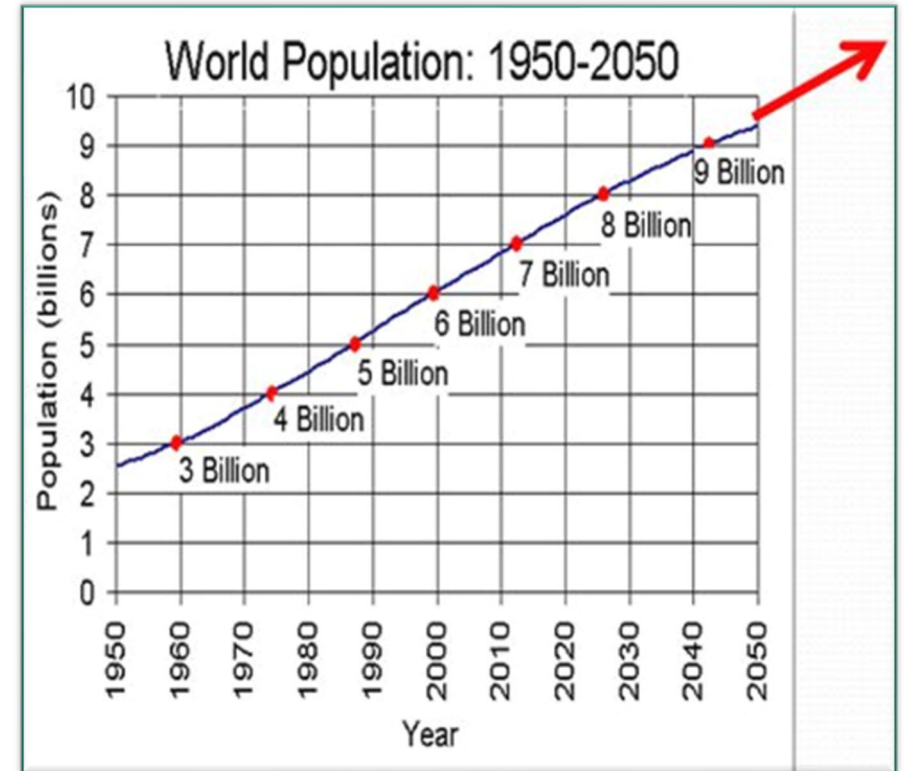


Our world's population is set to increase by a third by 2050 to **9.6 billion**.



In just **35 years**, there will be roughly **2 billion more people on the Earth**.

Source: #AgVocate <https://t.co/MaxvmLWVU> June 21, 2015



Source: U.S. Census Bureau, International Data Base, Aug. 2006 version

Pesticide usage on citrus is a mitigation strategy to eliminate pests, improve quality and yield and provide post-harvest protection.

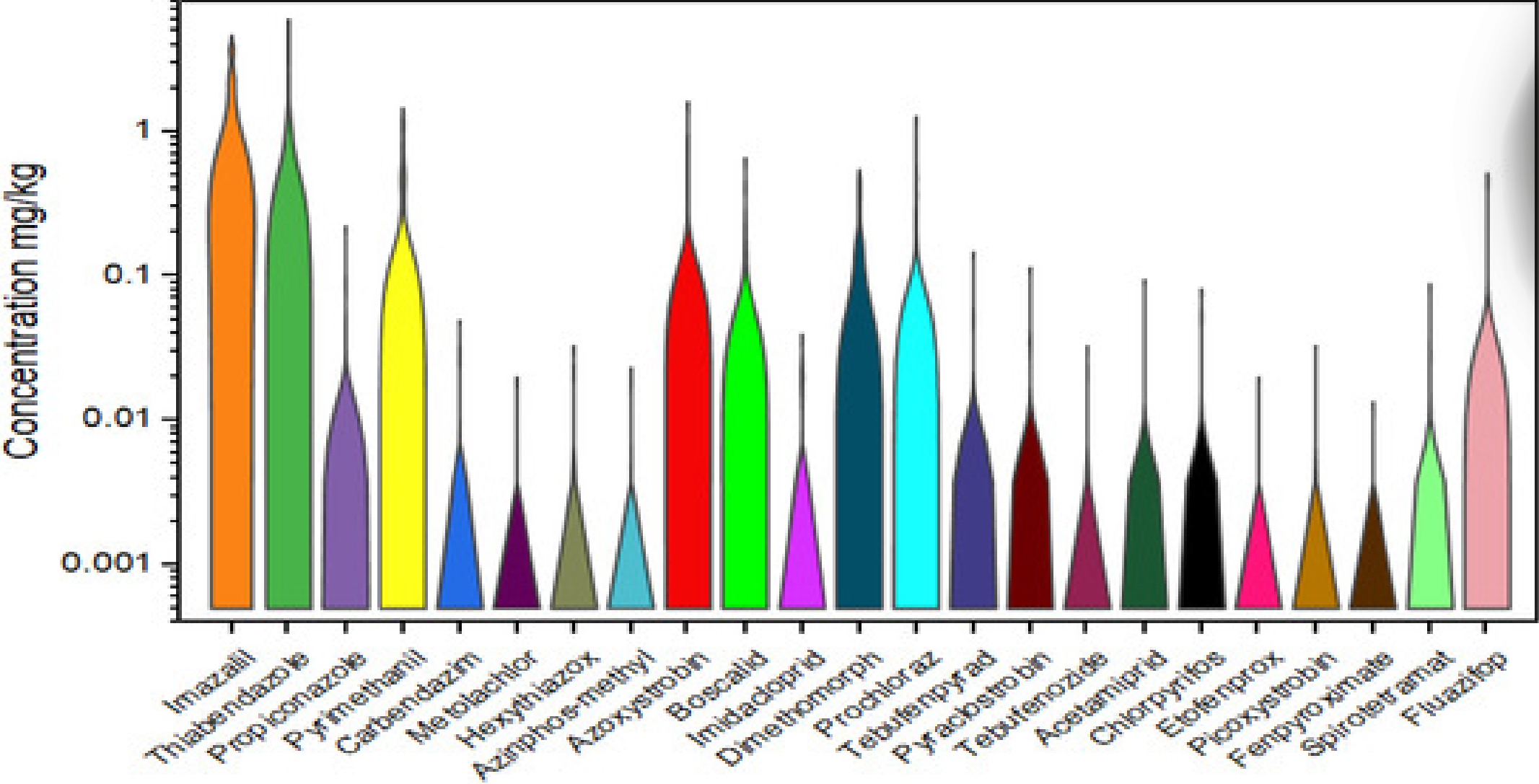
“Pesticides” include fungicides, rodenticides, bactericides, insect and animal repellents, and antimicrobials

Citrus Production

Hundreds of pesticides are registered for citrus applications for pre- and post-harvest applications.

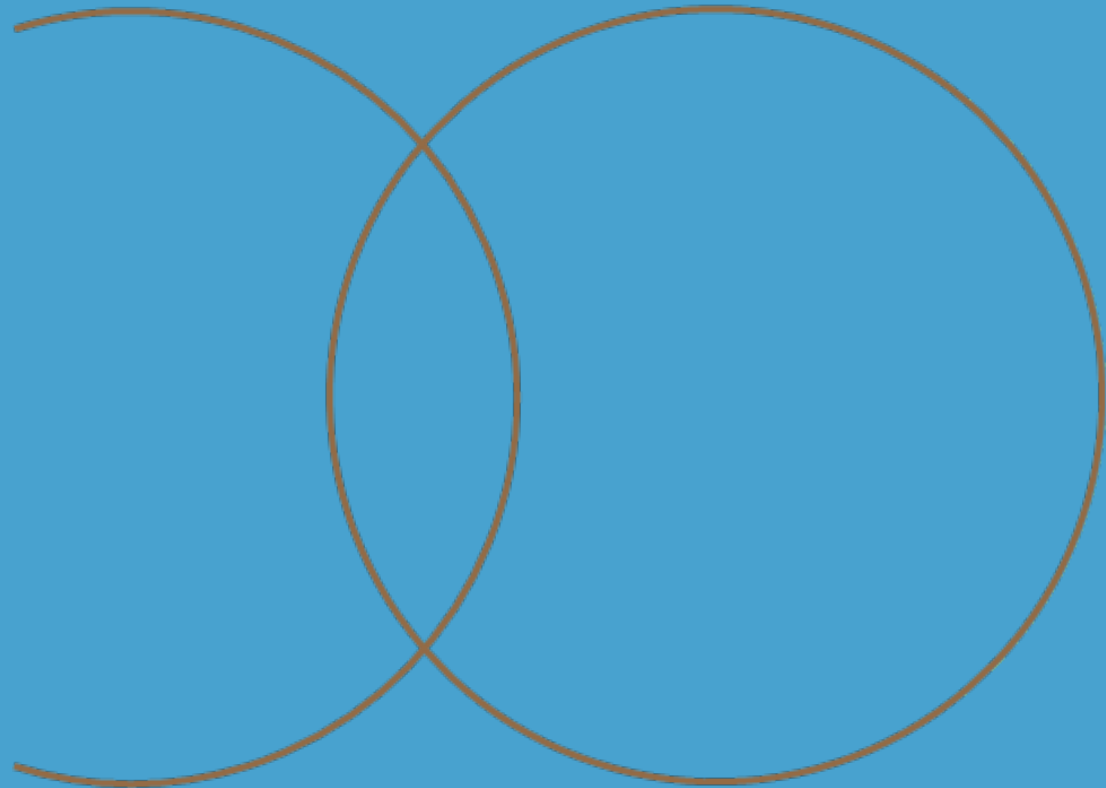
Fruit processing can result in presence of residual pesticides in processing products: juice, oils, peel, pellets, etc.

Typical Pesticides found in Oranges

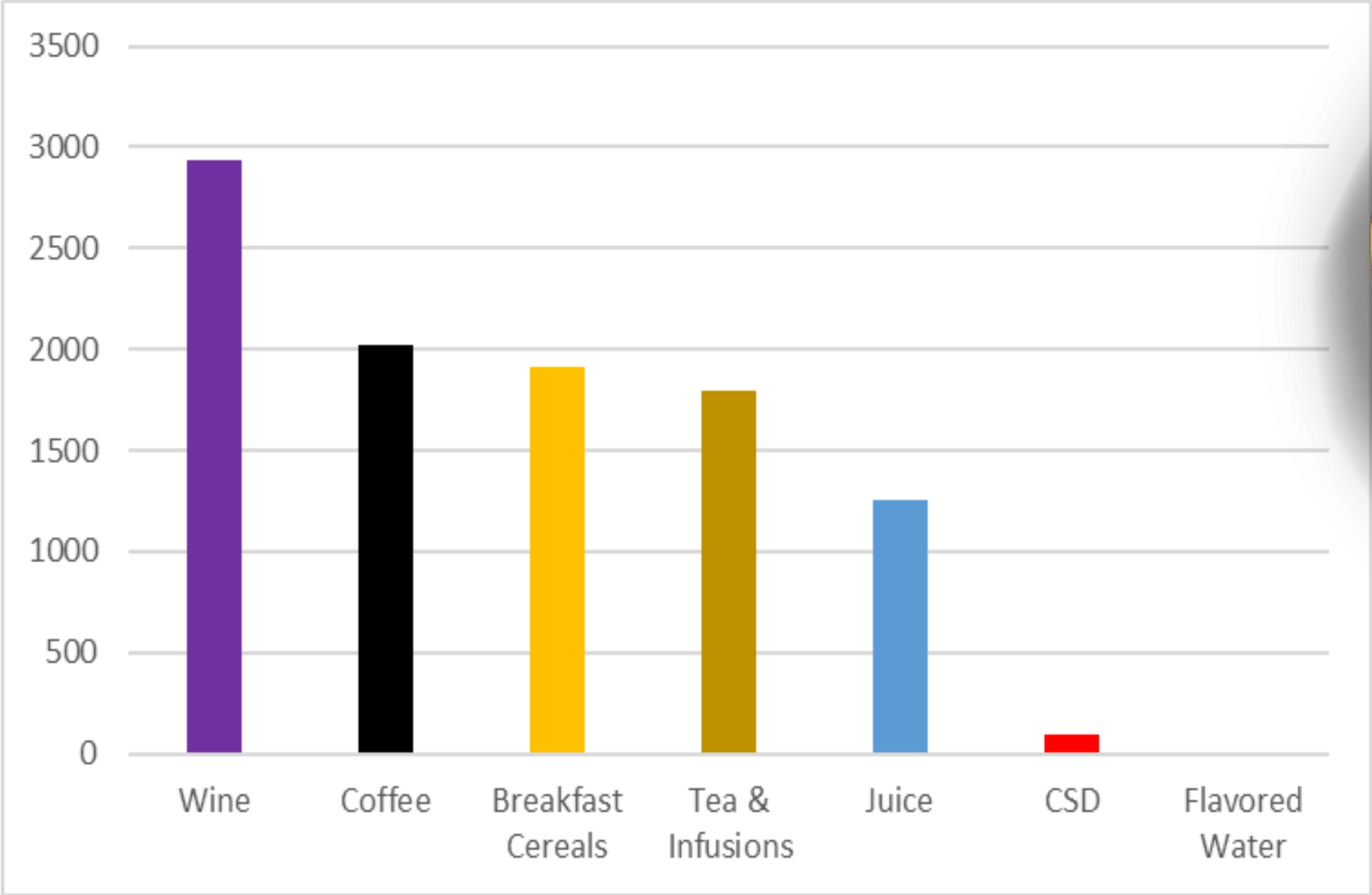


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Reality of Media Influence



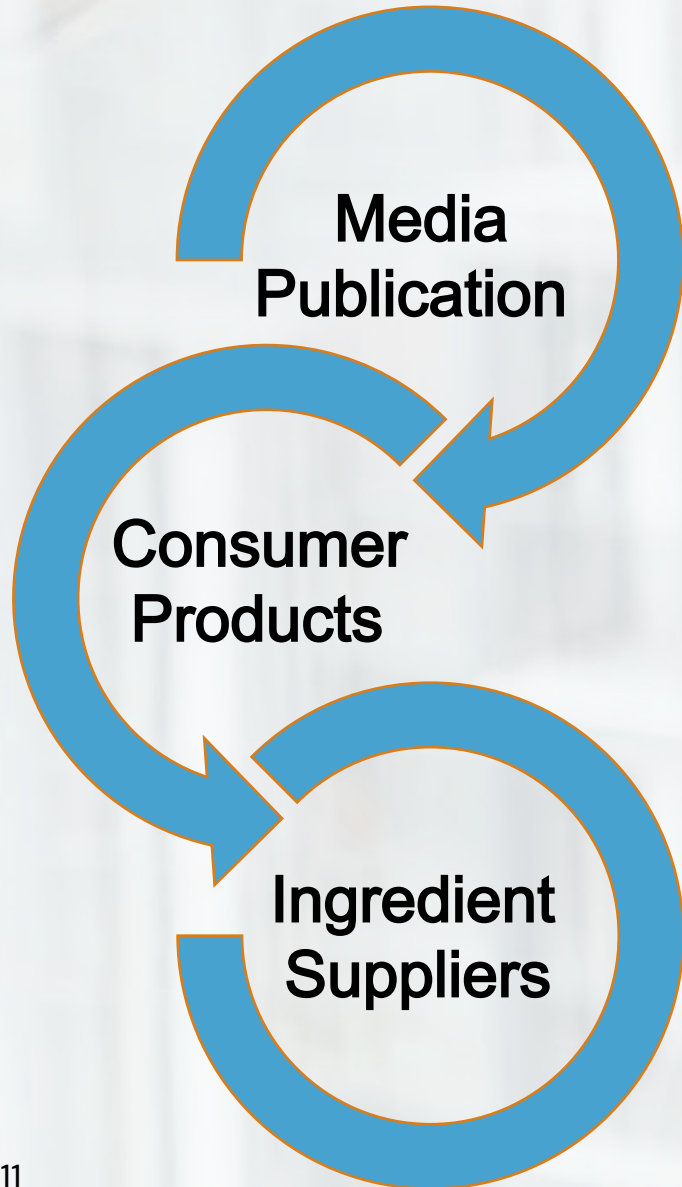
Applications in which pesticides are mostly discussed online



Source: SMI Study USA/UK/FR, Feb 2019 – Dec 2021

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Trickle down effect

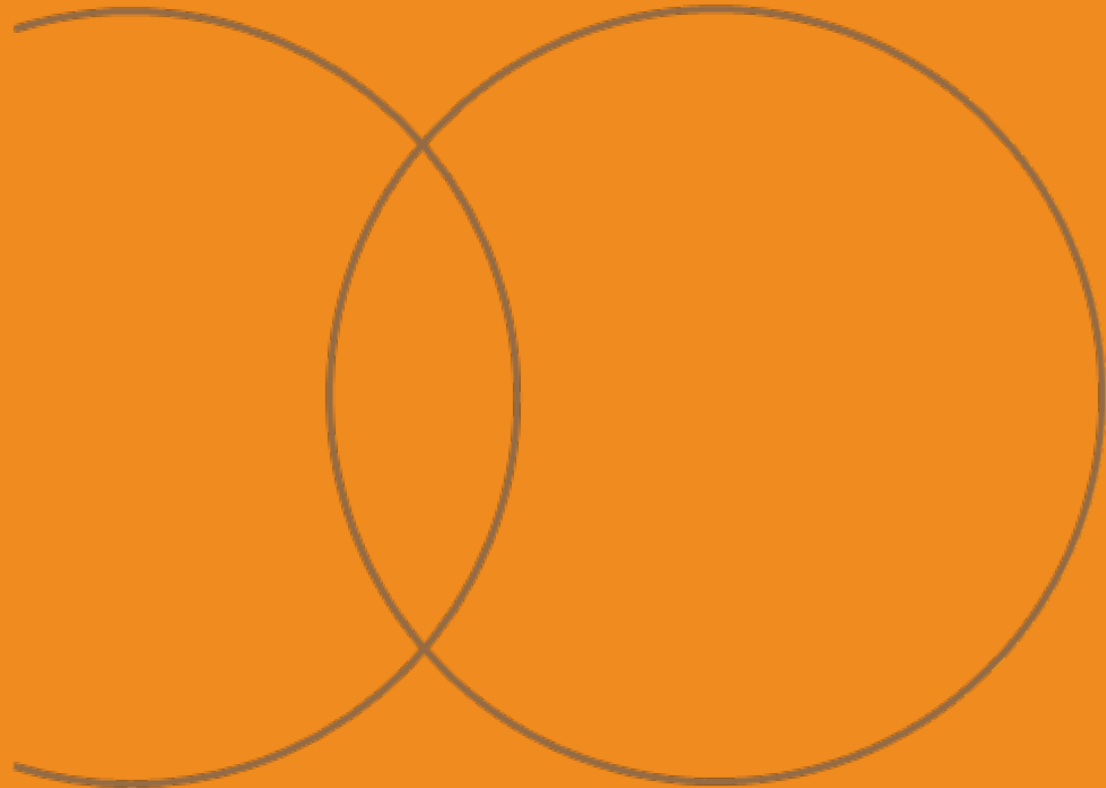


Major Brands Highlighted in Media

- ❑ 2006 India – Pesticide cocktail found in CSD
- ❑ 2018 Glyphosate levels in OJ
- ❑ 2022 Pesticides in tea and herbal tea bags

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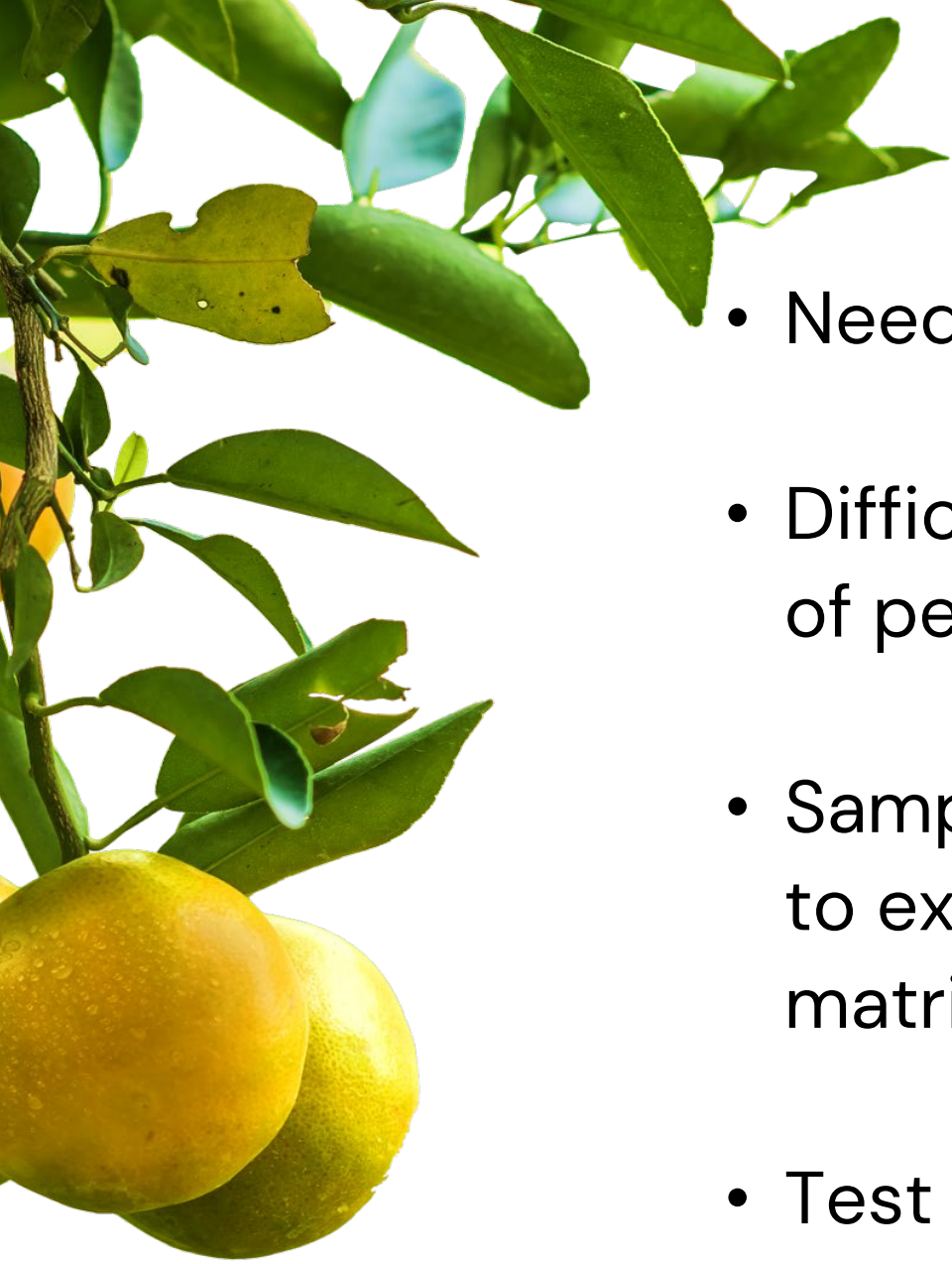
MRL Regulation and Testing



Maximum Residue Limits (MRL)

- Primarily established for raw agricultural commodities (RAC)
- Globally not harmonized (EU, EPA, Codex, etc.)
- EU and US regulations state the use of process/concentration factors with a small amount identified in legislation





Analysis of Pesticides Residues in Food

- Need for multianalysis of all chemical classes
- Difficulties due to physiochemical properties of pesticides
- Sample preparation is biggest challenge due to expansive list of residues and complicated matrix
- Test methods among certified labs not harmonized

Orange Oil ppm Analysis



Chlorpyrifos	Lab 1	Lab 2	Lab 3
1X	3.62	3.70	2.98
5X	21.00	22.60	17.84
10X	22.10	35.90	31.65
Graph			
Malathion	Lab 1	Lab 2	Lab 3
1X	0.50	3.70	0.51
5X	2.81	2.40	3.30
10X	3.75	4.10	5.73
Graph			
Phosmet	Lab 1	Lab 2	Lab 3
1X	0.46	0.47	0.50
5X	3.03	2.70	3.50
10X	2.83	4.90	6.18
Graph			

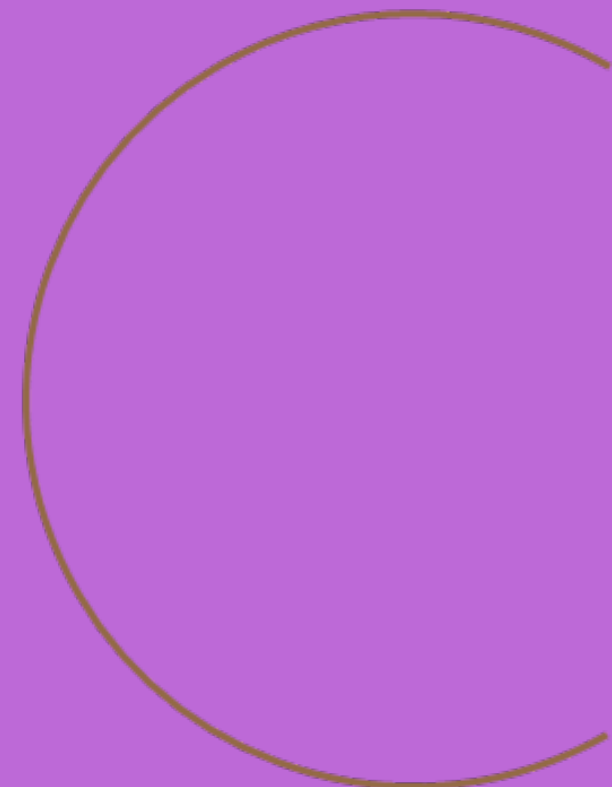
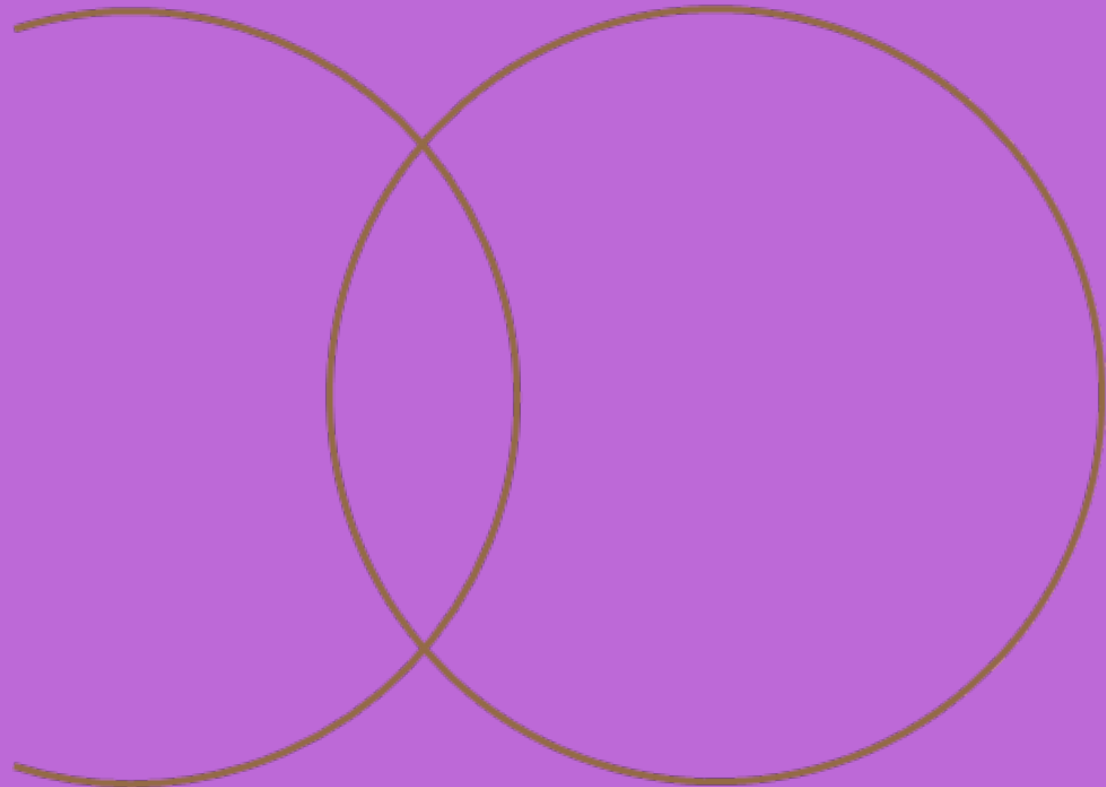
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Boiling Points - Citrus Compounds & Pesticides

	BP °C 760 mmHg	BP °C 25 mmHg
d-Limonene	176	74
Decanal	208	101
o-Phenolphenyl	256	141
Valencene	271	154
Malathion	313	190
Sinensal	335	208
Nootkatone	338	211
Chlorpyrifos	347	219
Pyrimethanil	363	232



Concentration & Processing



Concentration Factors and Processing Factors Defined

Concentration Factor – Based on Mass Yield and factor applied to all MRLs

	Mass Balance kg	Concentration Factor
Orange Valencia Fruit 1000 Boxes (90 lb/40.8 kg)	40.8	
Peel/Pulp/Seed	18.2	2.2
Juice	22.5	1.8
Cold Pressed Oil	0.11	370.9

Processing Factor – Ratio of individual pesticide in the processed product to that in the corresponding unprocessed product



Process Factor

- ❑ Takes into account the process effect on pesticide (concentration or dilution)
- ❑ AILIMPO study – not feasible to derive a single or generic lemon oil PF for all pesticides
- ❑ Studies are time-consuming and carry a cost



Process Factor – Orange Oil EFSA Database



Row Labels	Median PF Not Reliable	Row Labels	Median PF Reliable
Acequinocyl	x	Carbofuran	x
Azinphos-methyl	x	Chlorpyrifos-methyl	x
Azoxystrobin	x	Cyantraniliprole	x
Chlorpyrifos	x	Cyflumetofen	x
Fenazaquin	x	Flupyradifurone	x
Fenpyroximate	x	Imazalil	x
Fluopyram	x	Potassium phosphonates	x
Flupyradifurone	x	Spirodiclofen	x
Fluxapyroxad	x		

SOURCE: September 13, 2022

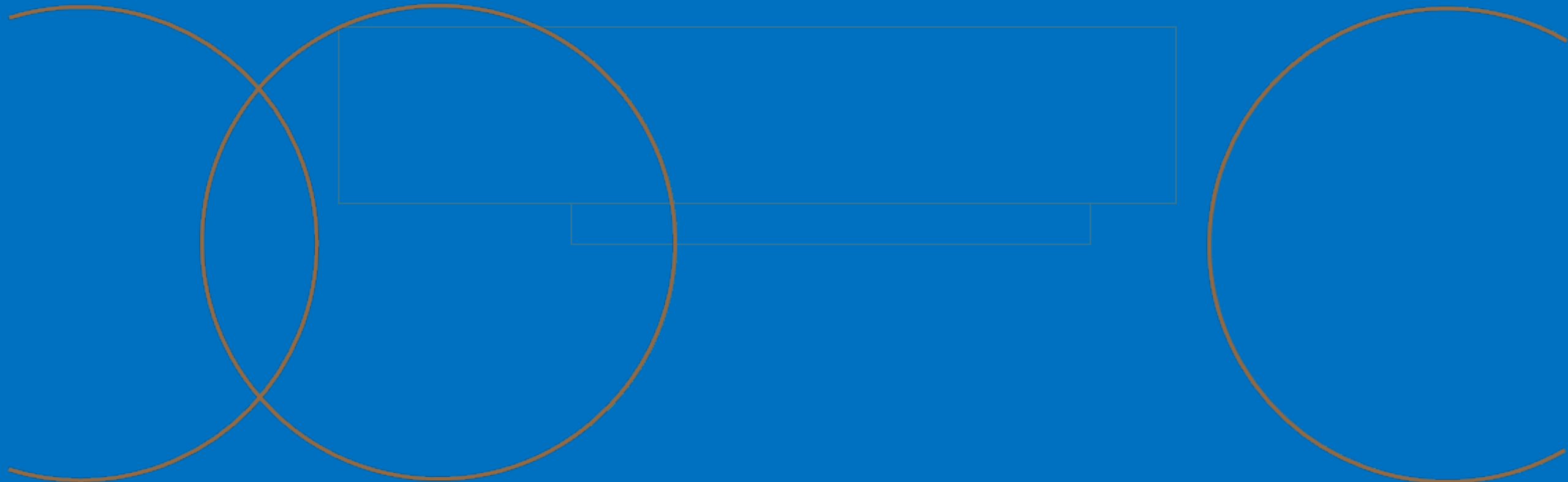
EFSA (European Food Safety Authority) database of processing factors for pesticides residues in food

Fosetyl-aluminium	x
Lufenuron	x
Pyridaben	x
Spirotetramat	x
Tebufenozide	x
Teflubenzuron	x

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Industry Issues & Possible Solutions



Issues Facing Industry (not inclusive list)

- Consumers rely on media information (misinterpreted)
- MRL are on fresh fruit (as consumed)
- Legislation for Concentration and/or Processing Factors inadequate
- Lack of harmonization MRLs
- Lack of harmonization on established analytical methods



Some Processes to Remove/Reduce Oil Pesticides

- **Acidic Hydrolysis (Resin or Wash)**
- **Fractional Distillation**
- **Supercritical CO₂**
- **Molecularly Imprinted Polymers (MIPs)**
- **Ionic Liquid Extraction**
- **Thin Film (molecular, falling film, wiped film)
Distillation**

Challenges

- **Not all pesticides removed with one process**
- **Oil quality affected**
- **Cost**
- **Volume constraints**

Collaborate with Industry & Regulatory Groups for concentration factors and/or processing factors

ICBC 2022 José Antonio García presented the AILIMPO study on establishing processing factor for lemon cpo working with EFEO and IFEAT for creation of an EFFA position paper.

UPCOMING: IOFI is planning a project is to establish processing factors (i.e. concentration or dilution factors) for the main agricultural residues found in flavourings and get official recognition in legislation.

Task: Membership survey – gather data on pesticides contained in flavourings



Industry Mitigation Examples

- Collaborate with Industry & Regulatory Groups for concentration factors and/or processing factors
- Remove/Reduce Pesticides before processing
 - Current wash process target microbial mitigation
 - Determine wash process for pesticides
- Packing House – wash process for eliminations prior to processing
- Lobby legislature to specifically address MRL for 'as consumed' food (beverages, etc..) and not the individual ingredients (flavours)



CFR 21- PART 570 -- Sec. 570.19 Pesticide chemicals in processed foods.

When pesticide chemical residues occur in processed foods due to the use of raw agricultural commodities that bore or contained a pesticide chemical in conformity with an exemption granted or a tolerance prescribed under section 408 of the act, **the processed food will not be regarded as adulterated** so long as good manufacturing practice has been followed in removing any residue from the raw agricultural commodity in the processing (such as by peeling or washing) and **so long as the concentration of the residue in the processed food when ready to eat is not greater than the tolerance prescribed for the raw agricultural commodity.**

In other words, MRL adherence is in the final consumed product and not in processed product (ie., citrus oils, flavours)??

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THANK YOU

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