USDA Pesticide Data Program

Over 30 Years of Monitoring America's Food Supply

Brenda Foos, Director

Monitoring Programs Division,

Science & Technology Program

PDP Mission

Provide high quality, nationally representative pesticide residue data for US foods

*Fulfills USDA's responsibility under the Food Quality Protection Act of 1996 (FQPA)*
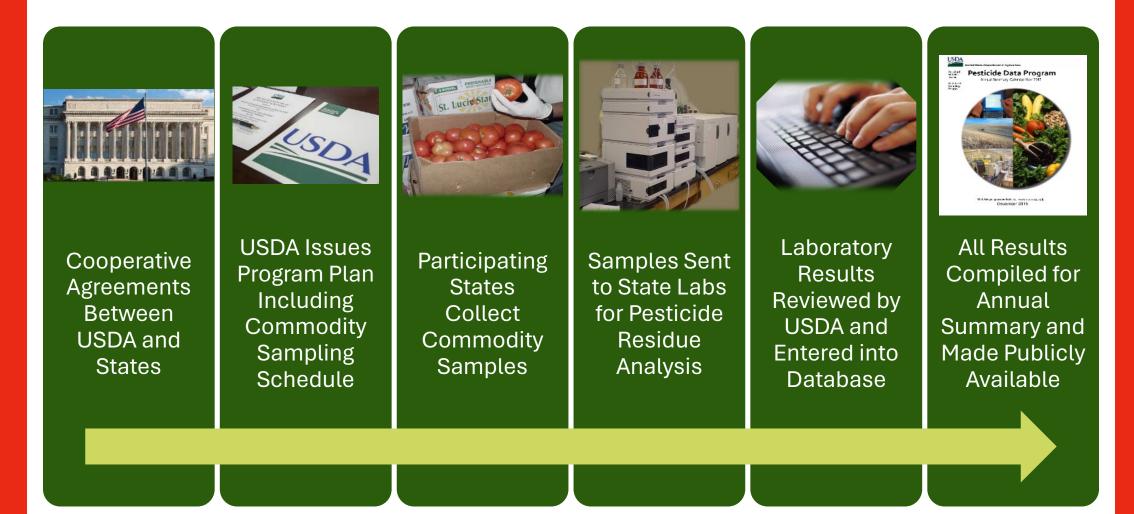
Provide the Environmental Protection Agency (EPA) with data for dietary risk assessments and pesticide registration review decisions and tolerances

Provide information to the Food and Drug Administration (FDA) for planning purposes
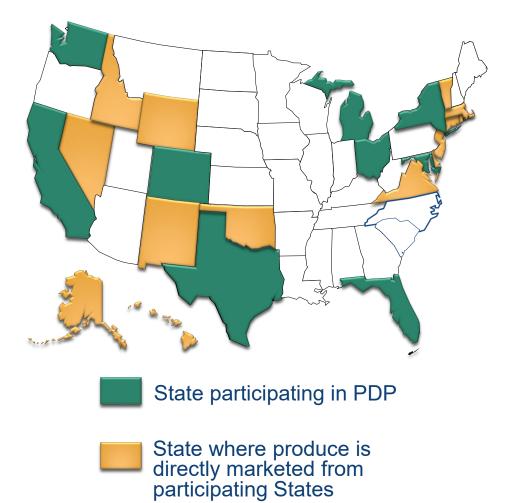
Support marketing of U.S. commodities

Contribute to the information available to help ensure consumer confidence in the foods they provide to their families

PDP Operations Overview

PDP Participating States

State participating in PDP

State where produce is directly marketed from participating States

- Cooperative Agreements with
- State Departments of Agriculture

- PDP chemists serve as State liaisons

- PDP staff provide logistical and operations support

Commodity and Pesticide Selection

- In collaboration with EPA
- Commodities Rotate
  - One- or two-year sampling and approximately five-year intervals
  - Emphasis on high consumption commodities and the diets of infants and children
- Pesticide Analytes
  - Priority given to pesticides with a tolerance for the commodity
  - Other priorities based on data needs of EPA, FDA and USDA's Foreign Agricultural Service

PDP Commodity Counts (1991-2023)
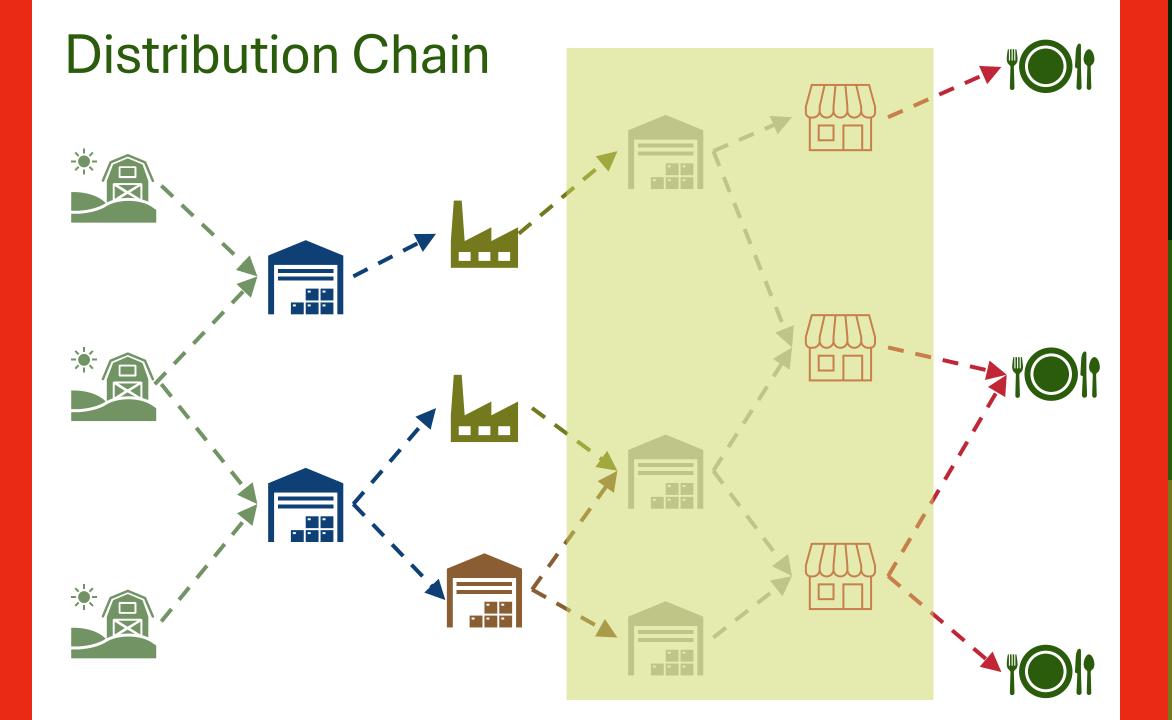
Commodity Type	Number of Commodities
Fresh Fruit and Vegetables	54
Processed Fruit and Vegetables	45
Grains	8
Meat/Poultry/Eggs/Fish	10
Dairy	3
Eggs/Honey	2
Nuts	2
Water	4
Infant Formula	2
Total Number of Commodities Tested	**130**

Sampling Approach

- USDA's National Agricultural Statistics Service (NASS) sampling framework
  - Representative of U.S. population
  - Site selection based on probability-proportional-to-size
  - Voluntary participation for collection sites: major food distribution centers and terminal markets
- Random sampling includes:
  - domestic & imported
  - organic & traditionally-grown foods

Distribution Chain

Sample Collection

59 monthly samples for each commodity

=

➤ 800 samples per month

➤ 700 samples per commodity per year

- Trained State sampling personnel
- Sample information captured onsite via tablet/laptop and sent to PDP
- Samples shipped to labs

**State Samples
Per Commodity Per Month**
(apportioned by population)

California	13
New York	9
Texas	8
Florida	7
Michigan	6
Ohio	6
Maryland	4
Washington	4
Colorado	2

Laboratory Sample Preparation and Residue Extraction

- Sample condition is inspected
- Prepared using common consumer practices
- Samples are homogenized

QuEChERS
Quick
Easy
Cheap
Effective
Rugged
Safe

Laboratory Analysis

- One or two laboratories analyze each commodity

- Pesticides / metabolites / isomers using multiresidue methods

- Compounds tested are commodity-specific

- State-of-the-art instrumentation
  - GC/MS-MS and LC/MS-MS
  - Low Limits of Detection (LODs): typically parts-per-billion

PDP QA/QC Program

- Method validation required for each new commodity and pesticide

- Blanks, spikes, and process controls used with each sample set

- Participation in Proficiency Testing required

- International accreditation required (ISO/IEC 17025:2017 + AOAC Guidelines)
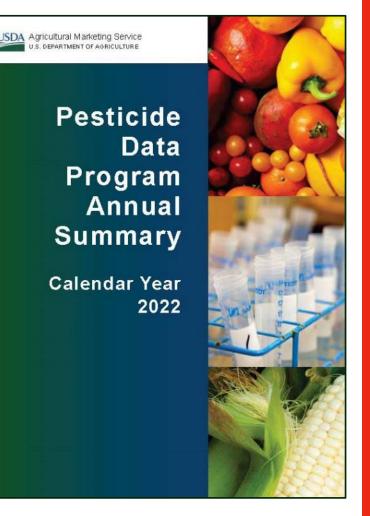
- PDP SOPs

All PDP Data are Publicly Available

- **Annual Summary**
  - Website
  - Printed copy (up to 2022)
- **Downloadable Database**
  - Data for specific commodities
    - and pesticides
- **PDP Database Search App**

www.ams.usda.gov/pdp
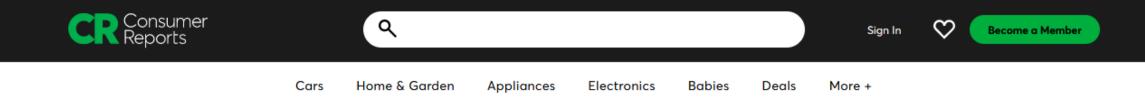
Supporting Marketing of U.S. Commodities

- **Fipronil in eggs**
- At least 40 countries, including 25 in EU, and Hong Kong affected, with Belgium & Netherland first reporting in 2016
    - More than a million eggs recalled
- Korea, Taiwan and other countries approached USDA on US eggs
- 1036 eggs tested by PDP in 2016, 2011 and 2010
- No Fipronil detected
    - LOD: 0.003 ppm and EPA TOL: 0.03 ppm

- **Cyantraniliprole in milk**
- Cyantraniliprole is used as insecticide to treat cattle feed crops
- Industry wanted to know cyantraniliprole in US milk to address dairy cattle growers' concern
- No cyantraniliprole detection in 1419 samples tested in 2017, 2016 and 2010; LOD 0.0025 ppm and EPA Tolerance: 0.20 ppm

Health / Food / Produce Without Pesticides

Produce Without Pesticides

Some of our favorite fruits and vegetables carry unhealthy levels of chemicals. CR's exclusive ratings reveal how to get the benefits from these foods while minimizing your risk.

33 YEARS
1991 to 2024

PERSPECTIVE   OPEN

Check for updates

Pesticide data program: 30 years of food residue data and trends

Chris Pappas[1] and Brenda Foos [ID][2]✉

The USDA's Pesticide Data Program (PDP) celebrated its 30th anniversary in 2021 and is one of the world's largest monitoring programs for pesticide residues. The PDP database contains over 42 million data points for a pesticide paired to a commodity that have resulted from the analysis of nearly 310,000 food samples of 126 different commodities. Over the decades of the program, sampling methods and infrastructure, major milestones, developments, and accomplishments have unfolded. Comparisons of data for four commodities that were in the program early on illustrate that over time pesticide residues on foods change, particularly when new pesticides are registered, and updated data, such as those provided by PDP, are key for exposure and risk assessment.

Keywords: Pesticide Data Program; PDP; Pesticide residues; Food safety; Food monitoring

https://www.nature.com/articles/s41370-022-00482-1.pdf

PDP – Then and Now

At the start - 1991

35 samples/month

3 commodities

11 pesticides tested/sample

Luke extraction

HPLC, GC/FPD, ELCD, MSD, XSD

2021

881 samples/month

15 commodities
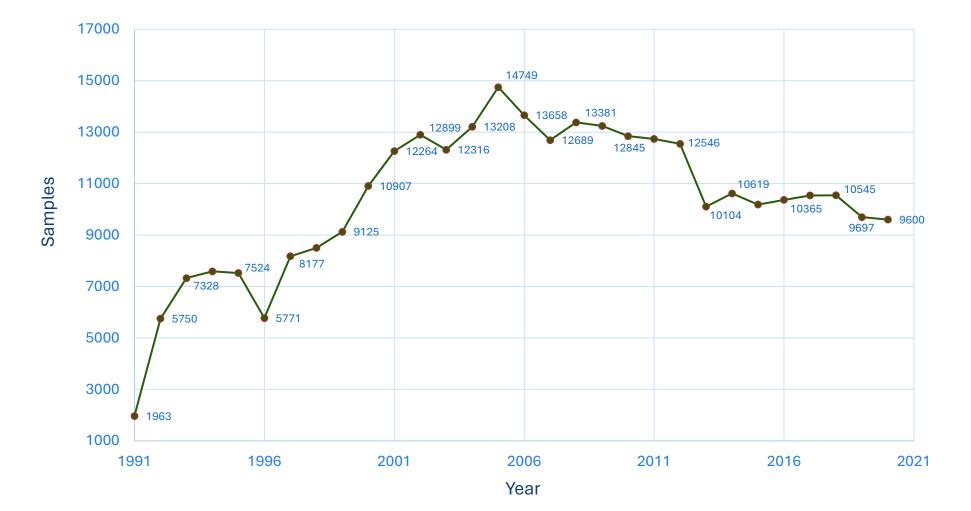
500+ analytes tested/sample

Quechers extraction

LC/MS/MS and GC/MS/MS

42 million pesticide-commodity data pairs

Samples by Year

Results per Sample

Average (Mean) Number of PDP Results Reported per Sample by Year

Fig. 1 **Mean results per sample.** Average (mean) number of PDP results reported per sample by year.

Apples!

1994 Top 10
Most Frequently Detected

Diphenylamine (DPA)

Thiabendazole

Azinphos methyl

Propargite

Carbaryl

Chlorpyrifos

Methoxychlor Total

Captan

Endosulfans Total

Dimethoate

2016 Top 10
Most Frequently Detected

Diphenylamine (DPA)

Thiabendazole

Fludioxonil

Pyrimethanil

Acetamiprid

Chlorantraniliprole

Boscalid

Pyraclostrobin

Spirodiclofen

Carbendazim (MBC)

Apples
Azinphos methyl & Fludioxonil

Comparison of Azinphos Methyl (AZM) and Fludioxonil Dectection Rates (%D) in PDP Apple Samples
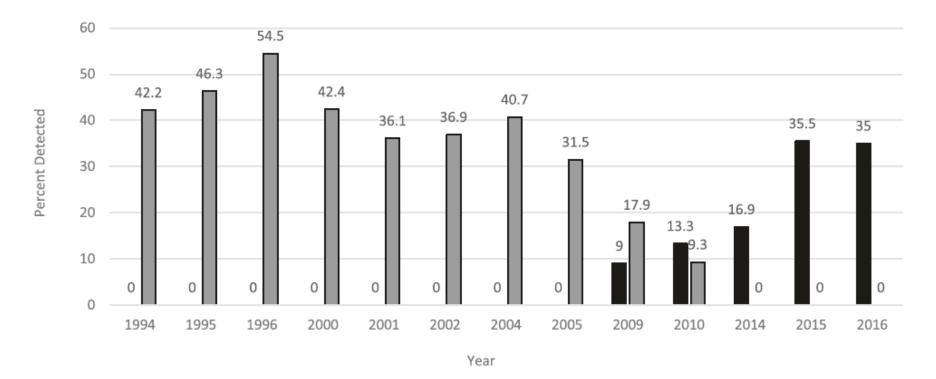

Fig. 2 Detection rates of select pesticides in apples. Comparison of azinphos methyl (AZM) and fludioxonil detection rates (%D) in PDP apple samples.
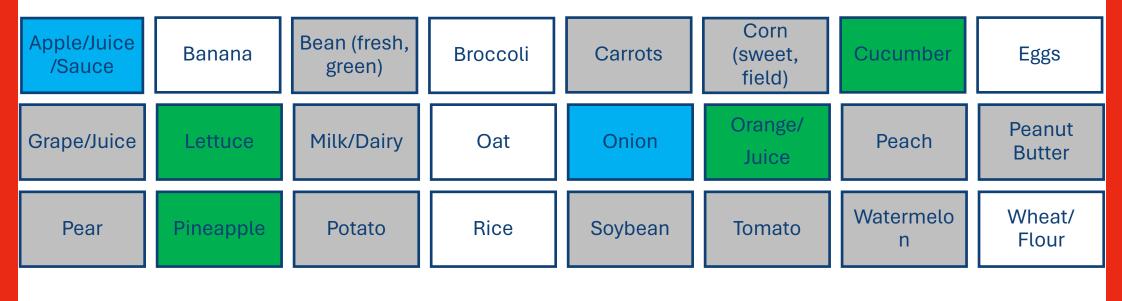
2022 PDP Survey Results

A total of 10,665 samples were tested for different parent pesticides, metabolites, degradates, and isomers.

- 27.6% of tested samples had no detectable pesticides

- 26.3% contained 1 pesticide

- 46.1% contained more than 1 pesticide

  - A maximum of 18 pesticides were detected in one sample of grapes and one sample of pears.

    - None of the residues detected exceeded the established tolerance; however, one residue in the grape sample did not have a tolerance established.

Parent compounds and their metabolites are combined to report the number of "pesticides" rather than the number of "residues". Environmental contaminants are excluded from the count of pesticides detected.

Children's Top 24 Consumed Commodities

Apple/Juice/Sauce	Banana	Bean (fresh, green)	Broccoli	Carrots	Corn (sweet, field)	Cucumber	Eggs
Grape/Juice	Lettuce	Milk/Dairy	Oat	Onion	Orange/Juice	Peach	Peanut Butter
Pear	Pineapple	Potato	Rice	Soybean	Tomato	Watermelon	Wheat/Flour
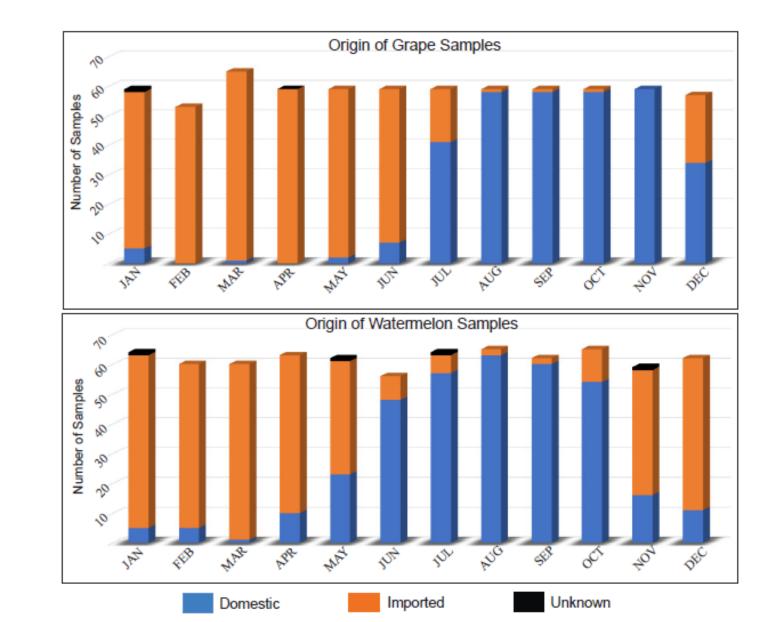
Tested in 2022   Tested in 2023   To be Tested in 2024

Top 24 commodities are based on *What We Eat in America (WWEIA)* surveys

Covid-19 Impacts on PDP Analysis

- COVID-19 related shortages extending into 2022 led to laboratory delays in reporting sample results

- Per the PDP SOP, sample results are to be transmitted by the laboratories no more than 90 days from the date of receipt of samples

- During 2022, 555 samples of celery and fresh/frozen peaches, 583 samples of potatoes and tomatoes, and 313 fresh/frozen blueberries and plums samples were held frozen for more than 90 days before analysis, (91-243 days)

- Data from these samples have been annotated with a special extraction code in the 2022 downloadable/searchable PDP data set

# 2022 Commodities with Cyclical Sample Origin
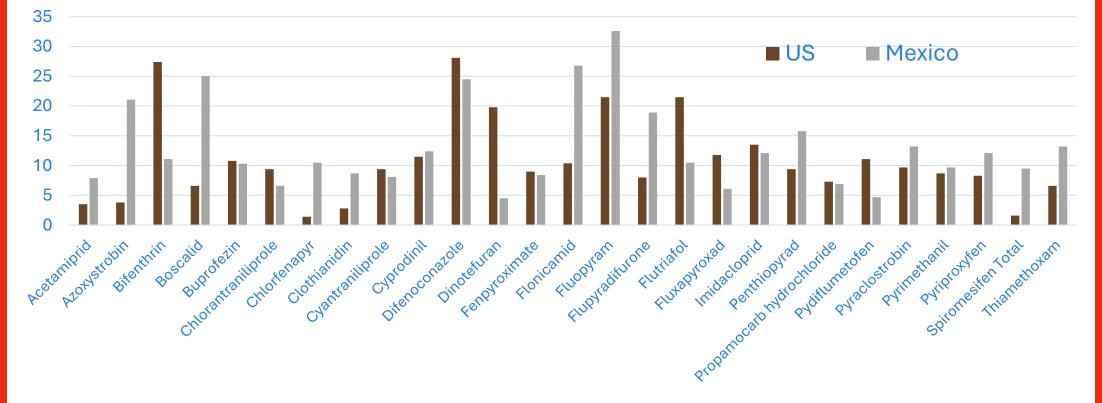
Grape
n = 706

Watermelon
n = 709

Environmental Contaminants Results

Analyte	Commodity	Sample Count	#Detections	%Detections	Action Level (ppm)
DDE p,p'	Butter	531	188	35.4	1.25
DDE p,p'	Summer Squash	269	14	5.2	0.1
DDT o,p'	Summer Squash	269	12	4.5	0.1
Dieldrin	Summer Squash	239	9	3.8	0.1
DDT p,p'	Summer Squash	208	7	3.4	0.1
Heptachlor epoxide	Summer Squash	530	17	3.2	0.05
Chlordane cis	Summer Squash	269	7	2.6	0.1
DDE p,p'	Potatoes	529	12	2.3	1.0
Chlordane trans	Summer Squash	269	6	2.2	0.1
DDE p,p'	Celery	706	10	1.4	0.5
Endrin	Summer Squash	530	7	1.3	NT

Samples shown have a detection rate of >1%.

2022 Presumptive Tolerance Violations

PTV Exceeders

Pesticides exceeding the tolerance were detected in 56 samples (0.53%) of the total 10,665 samples tested.

	Domestic	Imported
PTV Exceeder samples by origin	19	37
PTV Exceeders by origin (%)	33.9%	66.1%
Samples tested in 2022 by origin	7,738	2,848
PTV Exceeder rate by sample origin	0.25%	1.3%

There were no PTV Exceeders in unknown sample origin samples (76 samples) or mixed National origin samples (3 samples).

2022 Presumptive Tolerance Violations

PTV No Tolerance Established (NTE)

Pesticides with no tolerance established were detected in 269 samples (2.5%) of the total 10,665 samples tested.

	Domestic	Imported
PTV NTE samples by origin	127	142
PTV NTE samples by origin (%)	47.2%	52.8%
Samples tested in 2022 by origin	7,738	2,848
PTV NTE rate by sample origin	1.6%	5.0%

There were no PTV NTEs in unknown sample origin samples (76 samples) or mixed National origin samples (3 samples).

2022 Presumptive Tolerance Violation Distribution

Commodity	Samples with PTV exceeder violations
Green Beans	38
Grapes	6
Peaches, Fresh	4
Watermelon	4
Blueberries, Fresh	2
Peanut Butter	1
Tomatoes	1

All samples
- 56 samples with pesticides that exceeded the tolerance
- 269 samples had pesticides with no tolerance established

Commodities with no PTV exceeder detections
- Baby food – green beans, baby food –peaches, baby food – pears, baby food – sweet potatoes, butter, carrots, celery, corn grain, frozen blueberries, frozen peaches, mushrooms, pears, plums, potatoes, soybean grain, and summer squash.

Commodities with no PTV NTE detections
- Baby food – green beans, baby food – sweet potatoes, carrots, corn grain, and soybean grain
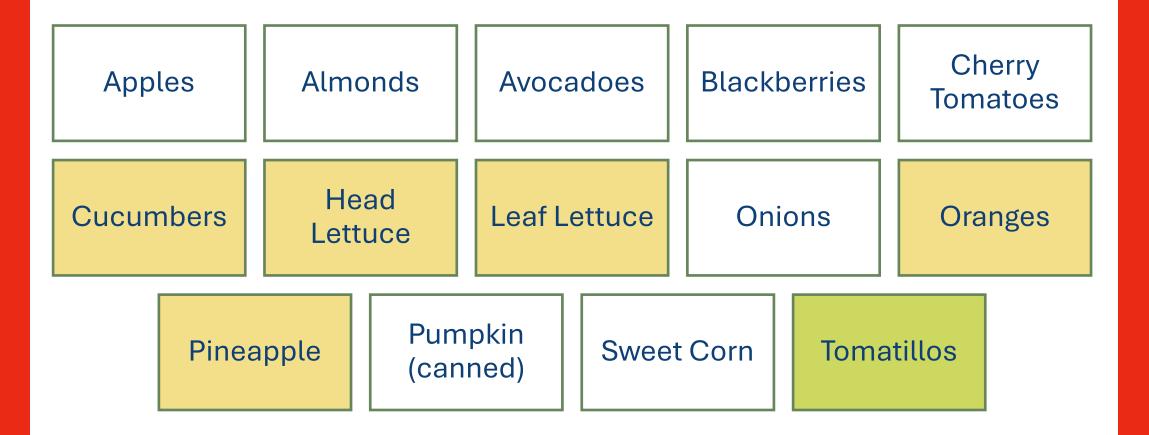
Number of PDP Samples with Presumptive Tolerance Violations (PTVs) by Year

2024 and Beyond – Current Commodities

Apples	Almonds	Avocadoes	Blackberries	Cherry Tomatoes
Cucumbers	Head Lettuce	Leaf Lettuce	Onions	Oranges
	Pineapple	Pumpkin (canned)	Sweet Corn	Tomatillos

Thank You

Contact:

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www.ams.usda.gov/pdp

Ohio™ THE HEART OF IT ALL™

"To protect Ohio citizens by ensuring the safety of the state's food supply and the health of Ohio's food animals and plant life, and to create economic opportunities for Ohio's farmers, food processors and agribusinesses."

75,800 Farms
13,700,000 Acres

4,750,000 Acres Soybeans

3,600,000 Acres Corn

From USDA/NASS 2023 State Agriculture Overview

1,920,000 Cattle
2,650,000 Hogs
127,400,000 Chickens
6,500,000 Turkeys

Annual Production
658,000,000 gal Milk
75,000,000,000 Eggs

13,300,000 tons Animal Feed Consumed[1]

2,054 Feed Registrants[2]
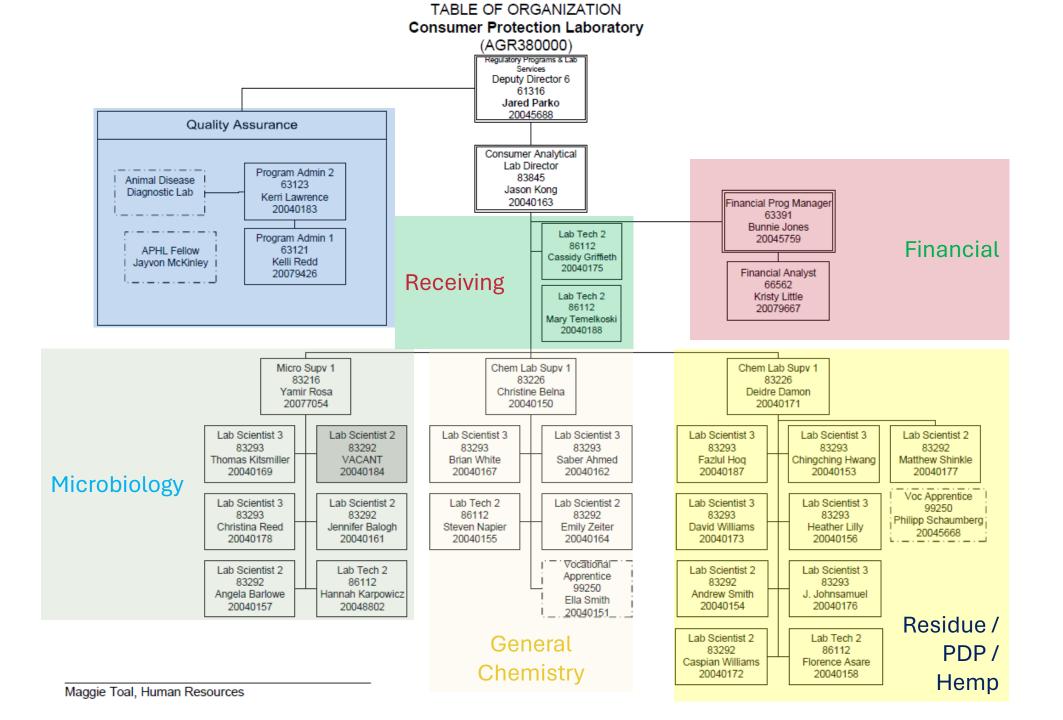
Consumer Protection Laboratory
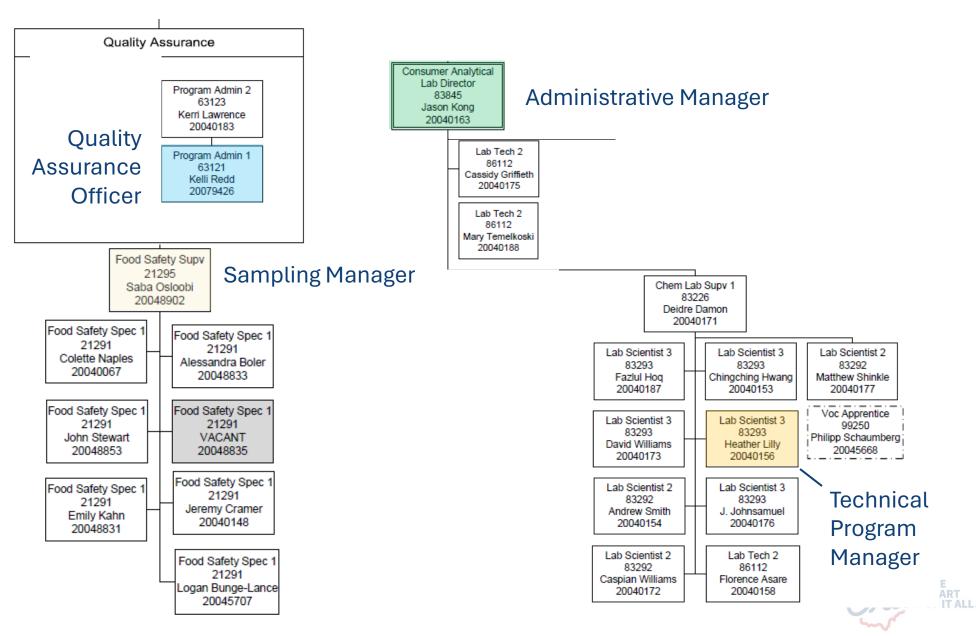
- **46,000+ sq ft facility built in 1996**
- **Basement expansion in 2003**
- **Analytical Chemistry**
- **Microbiology**

- **Also houses Analytical Toxicology Laboratory**
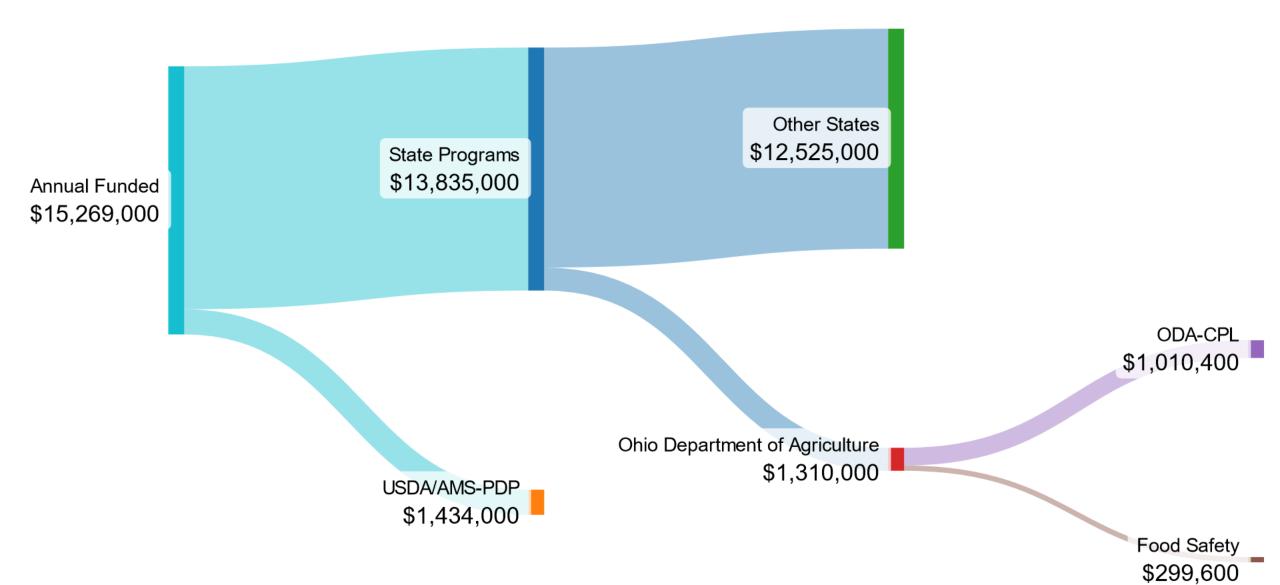
Dairy	Soil & Water Conservation	Livestock & Environmental Permitting	Pesticide & Fertilizer	Grain, Feed & Seed
Invasive Species	Meat Inspection	Food Safety	Ride Safety	Animal Health
Weights & Measures	Consumer Protection Lab	Commerical Dog Breeders	Animal Disease Diagnostic Lab	Analytical Toxicology Lab
Ohio Proud	Plant Diagnostic Lab	Ohio Wines	Dangerous Wild Animals	Farmland Preservation
Nursery Inspection	Hemp	Watersheds	H$_2$Ohio	Fairs

ODA's PDP Program

2024 Funding

Typical Analysis Workflow

PDP Commodities

Year	Commodities Assigned (OH)
2019	Bananas, Hot Peppers
2020	Bananas, Apple Juice
2021	Pears, Grape Juice
2022	Pears, Grapes
2023	Grapes, Infant Food (Carrots)
2024	Head Lettuce, Leaf Lettuce

USDA
PDP

United States Department of Agriculture
Agricultural Marketing Service, Science and Technology
Pesticide Data Program
Commodity Fact Sheet
(v1, Issued 12/1/23)

- **PRODUCT:** Head Lettuce (LH)

- **ACCEPTABLE PRODUCTS:** Fresh head lettuce (i.e., Iceberg lettuce). Wrapped or unwrapped. Import or domestic. Conventional or organic.

- **UNACCEPTABLE PRODUCTS:** Leaf lettuce (Romaine, green or red leaf lettuce, Bibb lettuce, coral lettuce, frisée, oakleaf lettuce, etc.), salad mixtures, pre-cut lettuce, washed lettuce, shredded lettuce, endive, escarole, spinach.

- **SAMPLE SIZE:** 5 lbs.

- **SPECIAL E-SIF INFORMATION:**
  - Commodity Type – Select "Fresh"
  - Container Type – Select the applicable container type (e.g., Bulk, Plastic bag, etc.).
  - Variety – Enter the variety name (e.g., Iceberg, etc.). Enter "Head Lettuce" if the variety is not known.
  - Brand – Enter the brand/trade name (e.g., Dole, Fresh Express, etc.). Enter "NA" if the brand/trade name is not known.
  - Lot number/Other ID – Enter the lot#/ product code (if there is more than one value, enter the additional lot number/product code info in the "Comments" field). Enter "NA" if the lot #/product code is not known.

- **PACKAGING AND SHIPPING:** Use cold packs as necessary, particularly during extreme summer temperatures. Susceptible to chilling injury. Desired shipping temperature range: 34 to 45°F (1 to 2°C). Use sufficient cushioning and packing materials to prevent bruising or crushing of lettuce during shipment.

- **DESTINATION:** All States ship to OH1.

This fact sheet is to be used in conjunction with all applicable PDP Standard Operating Procedures http://www.ams.usda.gov/pdp

Ohio
THE HEART OF IT ALL.
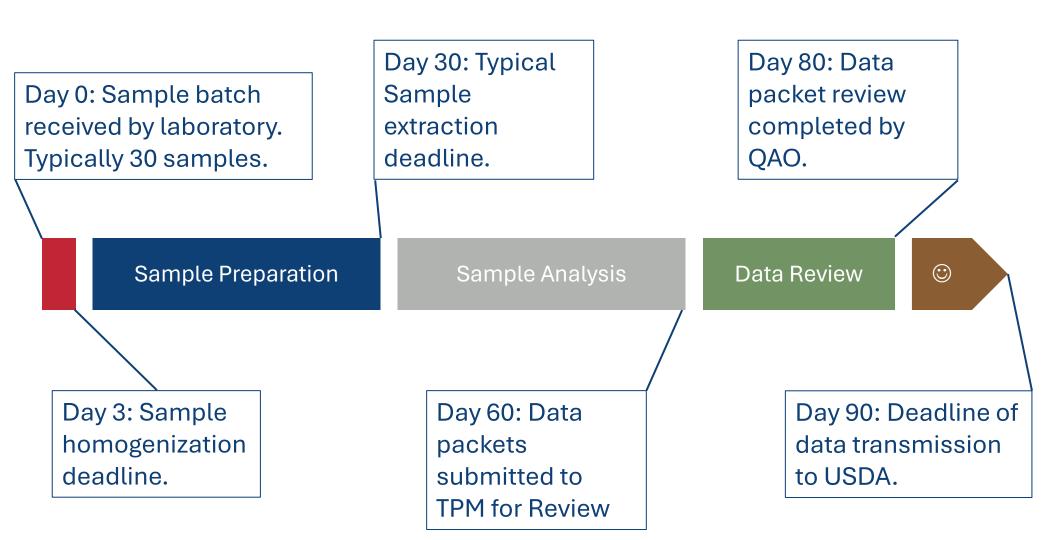
Commodity Milestones

2024 PDP Sample Collection Calendar   Batch = All samples collected within a certain work-week

January 2024

◄ Dec 2023   Feb 2024 ►

Sun	Mon	Tue	Wed	Thu	Fri	Sat
WEEK #1 **LEAF LETTUCE** **(LL)** **CA,NY,TX**	**1** **HOLIDAY** New Years Day	**2** CA – LL (13) NY – LL (9) TX – LL (8)	**3**	**4**	**5**	**6** 30
7 **WEEK #2** **LEAF LETTUCE** **(LL)** **CO,FL,MD,MI,OH,WA**	**8** CO–LL (2) FL – LL (7) MD – LL (2) OH–LL (6) WA – LL (4)	**9** MI–LL (6)	**10** MD – LL (2)	**11**	**12**	**13** 29
14 **WEEK #3** **HEAD LETTUCE** **(LH)** **CA,NY,TX**	**15** **HOLIDAY** Martin Luther King Jr.	**16** CA – LH (13) NY – LH (9) TX – LH (8)	**17**	**18**	**19**	**20** 30
21 **WEEK #4** **HEAD LETTUCE** **(LH)** **CO,FL,MD,MI,OH,WA**	**22** CO–LH (2) FL – LH (7) MD – LH (2) OH–LH (6) WA – LH (4)	**23** MI–LH (6)	**24** MD – LH (2)	**25**	**26**	**27** 29
28	**29** No samples!	**30** No samples!	**31** No samples!	No samples!		
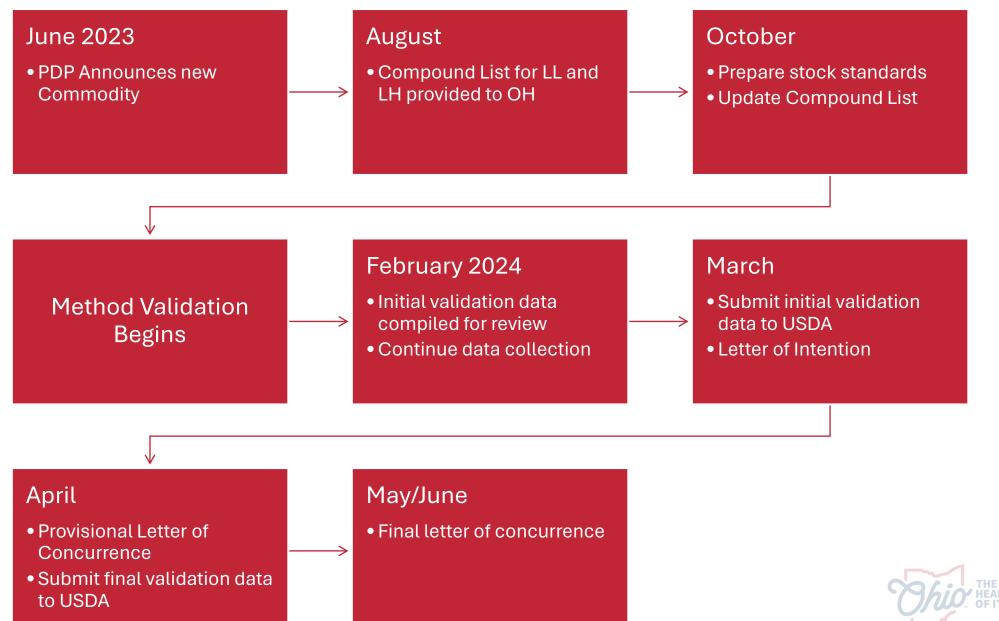
Typical Weekly ODA-CPL Milestones

Day 0: Sample batch received by laboratory. Typically 30 samples.

Day 30: Typical Sample extraction deadline.

Day 80: Data packet review completed by QAO.

Sample Preparation

Sample Analysis

Data Review

☺

Day 3: Sample homogenization deadline.

Day 60: Data packets submitted to TPM for Review

Day 90: Deadline of data transmission to USDA.

Ohio THE HEART OF IT ALL.

Commodity Validation Milestones

June 2023
- PDP Announces new Commodity

August
- Compound List for LL and LH provided to OH

October
- Prepare stock standards
- Update Compound List

Method Validation Begins

February 2024
- Initial validation data compiled for review
- Continue data collection

March
- Submit initial validation data to USDA
- Letter of Intention

April
- Provisional Letter of Concurrence
- Submit final validation data to USDA

May/June
- Final letter of concurrence

Ohio THE HEART OF IT ALL.

Sample Preparation / Homogenization
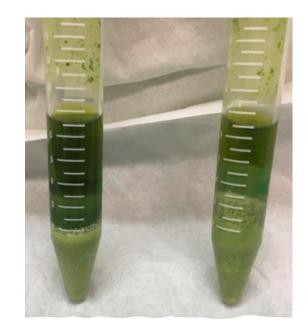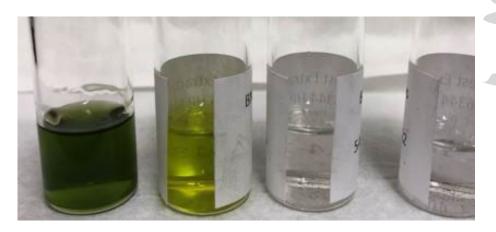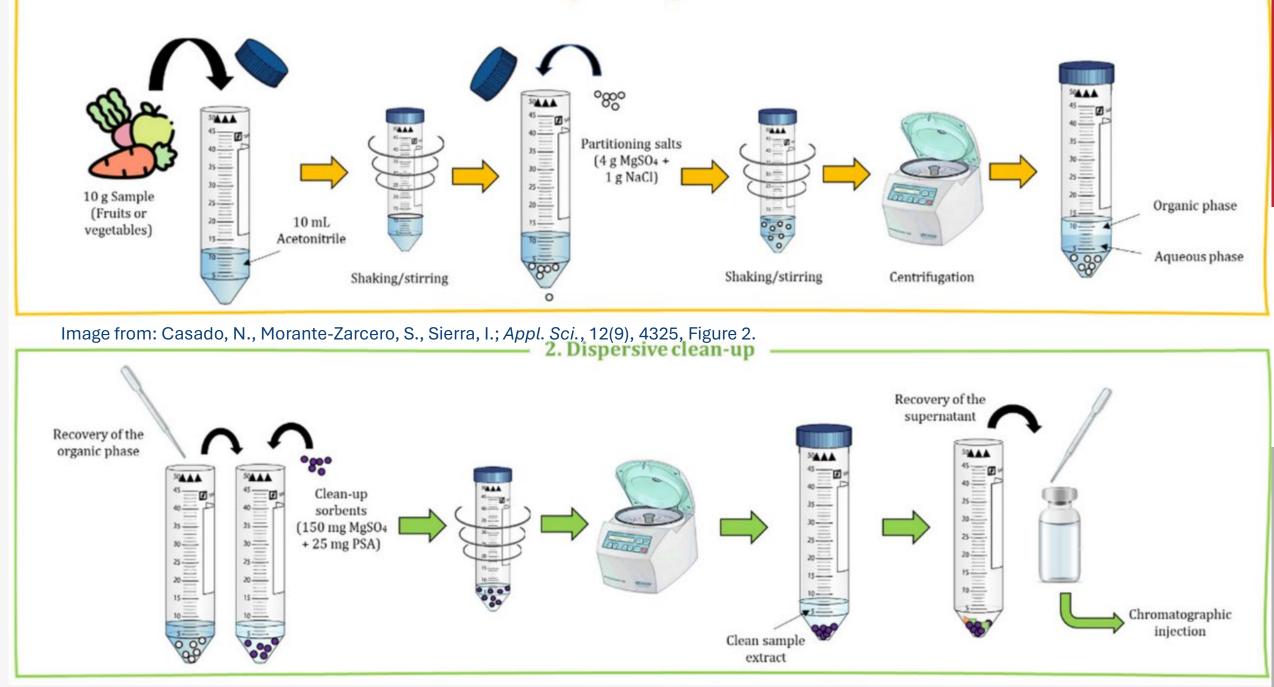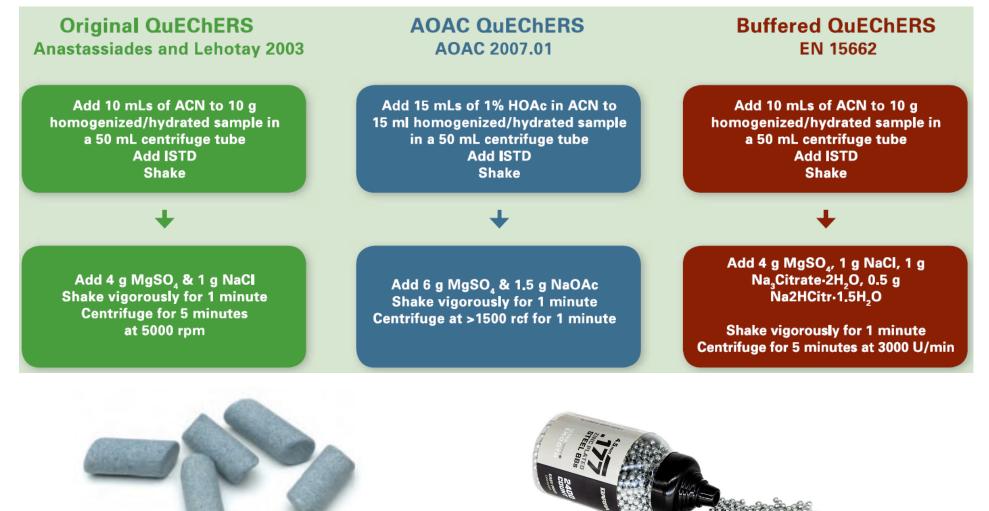
Sample Extraction / QuEChERS / Cleanup

Image from: Casado, N., Morante-Zarcero, S., Sierra, I.; *Appl. Sci.*, 12(9), 4325, Figure 2.

Options

Options Again

Restek

UCT

Biotage

Thermo Scientific

Phenomenex

PerkinElmer

Agilent

Waters
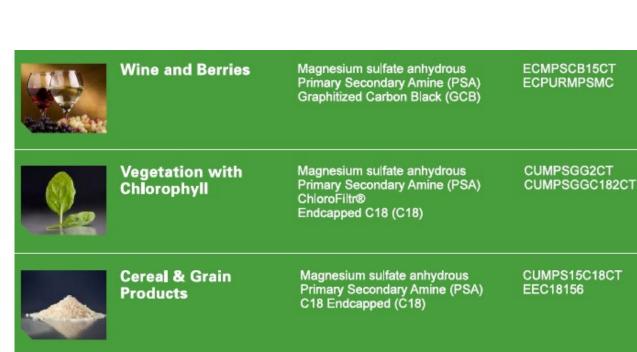
More Options

Matrix	Product Contents	Recommendations Part Number
Pigmented Fruits & Vegetables High pigmentation, some planar analytes	Magnesium sulfate anhydrous Primary Secondary Amine (PSA) Graphitized Carbon Black (GCB) Endcapped C18 (C18)	ECPSAC1856 ECQUEU1115CT ECQUEU32CT ECQUEU515CT ECPSACB256 ECPSACB6 ECPURMPSMC CUMC18CT ECMSC1850CT ECMS12CPSCPSA415CT
General Fruits & Vegetables Lightly pigmented	Magnesium sulfate anhydrous Primary Secondary Amine (PSA) Graphitized Carbon Black (GCB) Endcapped C18 (C18)	CUMPS2CT ECMS12CPSA415CT ECMSC1850CT CUMC182CT ECQUEU122CT CUMPSC1875CB2CT CUMPSC18CT ECQUEU1115CT ECPSACB256
Pigmented Fruits & Vegetables with waxes/lipids	Primary Secondary Amine (PSA) Graphitized Carbon Black (GCB) Endcapped C18 (C18)	ECPSACB6 ECPSAC1856
High Lipid Content (animal products, oils and nuts)	Magnesium sulfate anhydrous Primary Secondary Amine (PSA) Endcapped C18 (C18) Graphitized Carbon Black (GCB)	CUMPS15C18CT CUMPSC1875CB2CT ECMSC1850CT ECPSAC1856 CUMPSC18CT ECQUEU122CT ECPSACB6 EUSILMSSM26 ECMPSC1815CT EEC18156

Wine and Berries	Magnesium sulfate anhydrous Primary Secondary Amine (PSA) Graphitized Carbon Black (GCB)	ECMPSCB15CT ECPURMPSMC
Vegetation with Chlorophyll	Magnesium sulfate anhydrous Primary Secondary Amine (PSA) ChloroFiltr® Endcapped C18 (C18)	CUMPSGG2CT CUMPSGGC182CT
Cereal & Grain Products	Magnesium sulfate anhydrous Primary Secondary Amine (PSA) C18 Endcapped (C18)	CUMPS15C18CT EEC18156

From UCT Agricultural & Food Safety Analysis Brochure

Prior Commodities

Few Options

- Dropped Compounds
  - Method?
  - Matrix?
  - Instrument?

- Marginally Performing Analytes

pursued the addition of 17 new compounds for analysis. Some compounds from 2023 that had poor/inconsistent performance have been dropped after observation of continued performance issues in 2024 validation, and in line with the new guidance provided in regard to Marginally Performing Analytes (MPA). Ultimately, we intend to test for 235 total compounds in both LL and LH. Additional changes to LOQs were made in both GC-QQQ and LC-QQQ compounds largely to improve peak quality, or to address other challenges specific to the lettuce matrices. Please see the attached document itemizing all the changes from the 2023 panel to the 2024 panel.

We completed the Establishment and Verification of LOD/LOQ portions of method validation for pesticides in LH and LL, per USDA PDP-QC SOP Rev 12 Sections 5.10 and 5.11. We will continue to follow LOD=LOQ for these commodities.

Additionally, there was 1 compound that did not fit into a previously validated marker group based on the chemical group and instrument analysis combination. We have completed Determination of Method Range for this compound (Spiromesifen) per USDA PDP-QC SOP Rev 12 Section 5.13.

Process controls for 2024 analysis will continue to be propoxur for LC-QQQ, and ethoprop for GC-QQQ.
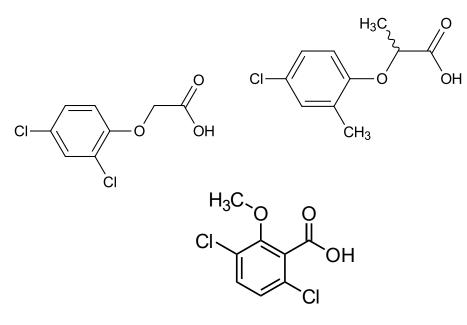
While we are still finishing official review of Precision and Accuracy data for compounds in LL and LH per USDA PDP QC SOP Section 5.14, we have enough initial data to recommend that the following compounds be considered as MPAs. We will code these compounds as MPA for now, and only amend coding if needed pending official review and Letter of Concurrence from USDA.
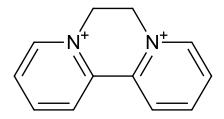
| LL	LH
Clofentezine	Ethoxyquin
Ethoxyquin	Monocrotophos
Mesotrione	Omethoate
Monocrotophos	
Omethoate	
Resmethrin	
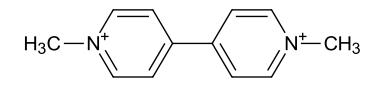
The attached forms reflect the verified LODs/LOQs for all compounds we intend to screen for in LH/LL, as well as Method Range Determination data. The data has been reviewed and approved by the TPM and QAO. Precision and Accuracy analysis is underway, and we will provide that data upon completion.

We look forward to your provisional letter of concurrence so we may begin routine analysis.

No Options (Yet)
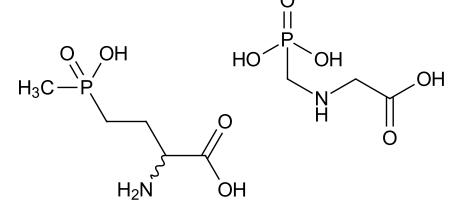
Phenoxy Acid Herbicides

Paraquat and Diquat

Glyphosate and Glufosinate

Sample Analysis / GC-MS & LC-MS

Data Analysis Summary

Data Analysis Summary Report

Group ID: APR-24 CDFA-257 CU   **Instrument: COMBO**   **Date/Initials: 4-26-24 HL**

Result Keys:

Confirmation/Determinative Codes:
GT/35: GC/MS/MS - Gas Chromatography with Tandem Mass Spectrometry - triple quadrupole
LU/52: LC/MS/MS - Liquid Chromatography with Tandem Mass Spectrometry - triple quadrupole

Quantitation Codes:
none/blank: No qualifications of data or non-detect
E: Estimate
P: Marginal performing analyte
U: Unvalidated compound

Annotation Codes:
Q: Residue at Below Quantifiable Level (BQL)
QV: Residue at <BQL> with a Presumptive Violation - No Tolerance
QX: Residue at <BQL> with a Presumptive Violation - Exceeds Tolerance
V: Residue with a Presumptive Violation - No Tolerance
X: Residue with a Presumptive Violation - Exceeds Tolerance

Mean Result Codes:
O: Detect: Original extraction value
R: Detect: re-extraction analysis value
A: Detect: average of original and re-extraction analyses values
UD: Unable to determine (matrix interference, method failure)

Compounds Detected:

Accession Number	Compound	Tolerance (ppb)	LOD (ppb)	Concentration (ppb)	Mean Result Code	Confirm-ation Code	Anno-tation Code	Quanti-tation Code
C2402921-A1	CARBOFURAN	NA	5	40.9	O	LU		
C2402921-A2	CARBOFURAN	NA	5	42.4	O	LU		
C2402921-Avg	CARBOFURAN	NA	5	41.7	O	LU		
C2402921-A1	PENDIMETHALIN		10	82.9	O	GT		
C2402921-A2	PENDIMETHALIN		10	75.8	O	GT		
C2402921-Avg	PENDIMETHALIN		10	79.4	O	GT		
C2402921-A1	PYRIPROXYFEN		12	70.3	O	GT		

Challenges for PDP

Funding

Continuing Resolutions

Updated Instruments

Technology

Going Paperless

Automation & Improved Processes

Analytical

Dirty Salts, Dirty Matrices

Commodity Validation Cycle

Challenges for PDP

Vendors	Inexperienced Service Engineers
	Securing Standards
	Helium Shortages
Sampling	Collection Criteria / Amounts
	Collection Sites
Personnel	Retention & Training
	Succession Planning

PDP's Effect on ODA-CPL

QUESTIONS?

Thank You!