

Heartland Health Research Alliance Comments Submitted to EPA Docket: HQ-OPP-2022-0490 Regarding “Petition to Revoke Tolerances and Cancel Registrations for Certain Organophosphate Uses”

The petition underlying this docket calls for four main actions by EPA impacting the human health assessments and regulation of OP insecticides:

- I. EPA must end its unreasonable delay and move expeditiously to protect people from the OPs.
- II. EPA must revoke tolerances and cancel registrations for food uses of OPs for which the EPA is **unable to determine** that there is a “reasonable certainty of no harm” stemming from current levels of OP dietary exposures.
- III. EPA must update its OP risk assessments to use a regulatory endpoint that will protect children from neurodevelopmental harm and the impacts of coformulants (i.e. “inert ingredients”) on the exposure levels and toxicity of end-use products.
- IV. EPA must cancel registrations allowing OP uses that pose significant risk of unreasonable adverse effects on applicators, farmworkers and other people exposed near recently treated fields.

Contents (relevance to petition outcomes in brackets)

1. Commenters’ Background	1
2. Synopsis of Comments	1
3. Brief History of EPA’s Regulation of OPs	5 [I]
Passage and Impacts of the FQPA.....	5
EPA’s First Concrete Actions under the FQPA.....	7
4. Critical Impacts of EPA Largely Ignoring the Inert Ingredients in OP Formulations.....	10 [IV]
5. Existing OP Benchmark Doses, cPADS and cRfDs.....	12 [III]
6. Dietary Exposures to OPs.....	15 [II]
OP Risk levels in Individual Samples	21 [I]
7. Trends in OP Use.....	23 [I-IV]
8. Alternatives to OP Insecticides.....	26 [I-IV]
Grower-Led Efforts to Reduce Reliance on High-Risk Pesticides.....	31
9. Economic Impact of OP Exposures	34 [IV]
10. Reducing Adverse Impacts of OPs on Farmworkers, Applicators and Rural Communities...37 [IV]	

1. Commenters' Background

We submit these comments on behalf of the Heartland Health Research Alliance (HHRA), a non-profit organization currently conducting research on the impacts of farming systems and herbicide use on women during pregnancy, the health of infants, children's development, and other public-health outcomes following exposures to pesticides (hh-ra.org).

Dr. Philip J. Landrigan is the Chair of the HHRA Science Advisory Committee. He is the founding director of Boston College's Program for Global Public Health and the Common Good and has been a long-time consultant to the World Health Organization. Dr. Landrigan Chaired the NAS Committee that wrote the seminal 1993 report *Pesticides in the Diets of Infants and Children*. This NAS project was largely funded by the EPA. In 1997-98, he served as Science Advisor for Children's Health to the Administrator of the US Environmental Protection Agency where he was instrumental in establishing EPA's Office of Children's Health Protection.

Dr. Kathleen Merrigan is the Chair of the HHRA Policy Committee and serves today as the Executive Director, Swette Center for Sustainable Food Systems at Arizona State University. She served as the Deputy Secretary of Agriculture from 2009-2013 and has played a leading role in multiple farmbills. Dr. Merrigan served on the EPA's Food Safety Advisory Committee in 1996, convened to help guide the agency's implementation of the Food Quality Protection Act. Through the course of her career, her focus has been shaping policies impacting agriculture's environmental footprint, food safety, food security and the nutritional quality of food, and how agriculture and food systems impact public health.

Dr. Charles Benbrook currently is the ED of the Heartland Health Research Alliance. He served as ED of the NAS Board on Agriculture when the Landrigan Committee was formed and supported the Committee's work through 1990. He carried out analytical work from 1994-2004 focused on the impacts of the Food Quality Protection Act on pesticide residues and risks, with special focus on organophosphate (OP) insecticides. He authored multiple comments to EPA throughout the FQPA implementation process. Dr. Benbrook has served as an expert witness in pesticide litigation, including cases involving OP insecticides.

2. Synopsis of Comments

For several decades organophosphate insecticides were the most heavily applied family of insecticides in the US and globally. By volume in the US, the two major uses of OPs have always been corn and cotton. Contemporary concerns over OP uses and risks arise largely from the impacts of OP on applicators and farmworkers, and the general public through

residues in food. Uses of OPs inside homes, other buildings and places where people congregate have in the past been a major focus of scientists and regulators, but nearly all such uses are no longer allowed. Recent EPA assessments of OP use, exposures and risks summarized in the petition provide ample evidence of the sometimes high worker and dietary risks stemming from certain uses of OPs, especially in fruit and vegetable production.

These comments lay out the major reasons we urge the EPA to act promptly and decisively in response to this petition by revoking all tolerances supporting food uses of the OPs. Each Section of these comments is relevant to one or more of the specific requests made in the petition.

After providing a brief overview of the country's 40-year effort to understand and curtail OP uses and risks, we highlight the encouraging progress the EPA and US farmers have made since 2000 in markedly reducing reliance on OPs through registration of lower-risk insecticides and adoption of prevention-based biointensive Integrated Pest Management (bio-IPM)¹ systems and other regenerative practices.

The pesticide industry deserves credit as well. Industry R+D investments over the last 20 years have brought to market dozens of reduced-risk and much-safer alternative insecticides and biopesticides.² Indeed, we are in the midst of what some entomologists call the "golden age" of insecticide discovery. Advances in science are supporting industry efforts to identify and synthesize new insecticides that work via modes of action impacting only certain insects, thereby reducing adverse impacts on biodiversity, other animals, and people.

The novel reduced-risk pesticide policies adopted by EPA in the 2000s also deserve credit in bringing about the substantial progress made to date in reducing OP use and risks. The new policies have dramatically reduced the time required to get a new, safer pesticide on the market and is a major reason why the farmer's insecticide toolbox remains well stocked.

Data we share in these comments show that reliance on OPs today has fallen nearly three-quarters from peak use in the 1990s, prior to the passage and implementation of the Food Quality Protection Act (FQPA). Most of the highest-risk OPs are off the market. But hundreds of OP tolerances remain on the books for which there is no corresponding registrations allowing use in the US. This allows continued use of many OPs abroad. These tolerances confer on growers outside the US a competitive advantage, because they can continue to use many older, low-cost but sometimes high-risk OPs, while US growers must

¹ For a full discussion of the characteristics, attributes and measurement of biointensive IPM, see *Pest Management at the Crossroads* published by Consumers Union in 1993.

² According to EPA "Biopesticides include naturally occurring substances that control pests (biochemical pesticides), microorganisms that control pests (microbial pesticides)..." that typically work through a non-toxic mode of action. <https://www.epa.gov/pesticides/biopesticides>

switch to multi-tactic IPM systems, coupled with often more-expensive, newer, reduced-risk insecticides. And because of efforts in much of the world to curtail OP use, there is excess OP production capacity globally and the cost to treat an acre of crops with high-risk OPs has fallen substantially.

This unwelcomed economic pressure on US growers is one of many reasons for EPA to act on this petition and revoke all tolerances supporting OP food uses.³ Data presented herein show clearly that uses of OPs abroad that are no longer allowed in the US are exposing US consumers, including pregnant women, infants and children, to worrisome OP residues in a range of foods. Current government testing at ports of entry into the US often detect now-illegal OP residues in imported foods, but rarely soon enough to keep high-risk fresh foods from reaching consumers. Data compiled by HHRA show clearly that the share of OP dietary risks stemming from several imported foods has been rising incrementally since the early 2000s, and now likely accounts for more risk than domestically grown crops (see tables in Section 6). It is also inevitable that ***until the EPA revokes all OP food-use tolerances, the well-documented neural developmental risks from OPs will remain a day-to-day reality for farmworkers, pesticide applicators, and American families raising young children.***

This petition provides the EPA with an opportunity to finish a task the agency and public health community has been working toward for 40 years. The EPA has spent far more of its always-limited resources trying to curtail OP risks than any other family of pesticide chemistry. Without doubt in the history of the US EPA, the most intensively studied and debated pesticide has been the OP chlorpyrifos.

Since passage of the FQPA in 1996, an inordinate share of the analytical capacity and scientific resources available to the EPA's Office of Pesticide Programs has been invested in chlorpyrifos and other OP risk assessments. While important progress has been made, it has come at the cost of less focus on other high-risk pesticides and pesticide uses. ***The only expeditious way to end food-crop uses of OPs is to revoke the remaining tolerances covering such uses.*** The legal justification for doing so is the inability of the EPA to determine that there is a "reasonable certainty of no harm" arising from contemporary levels of OP dietary exposure. This EPA determination is required by the FQPA.

Our comments also highlight several reasons why current EPA estimates of the dietary risks stemming from current uses of OPs, and OP residues in imported food, are underestimated. First and most significantly, EPA is regulating the remaining OPs on impacts on acetylcholinesterase inhibition. The agency continues to do so because it lacks the robust, extensive database on OP-neural developmental risks it drew upon in regulating chlorpyrifos. ***It is highly likely that the remaining OP tolerances and uses pose***

³ Revocation of OP tolerances is required to end the flow of imported fresh and processed foods and food ingredients that contain OP residues.

neural developmental risks at exposure levels 10-fold to 100-fold or more lower than current OP dietary exposure thresholds established on the basis of cholinesterase inhibition.⁴

Even with current, cholinesterase-based Benchmark Doses and chronic Population Adjusted Doses (cPADs), most OPs pose unacceptable dietary risks for certain vulnerable population groups or are close to doing so. In addition, excessive worker and applicator exposures occur every day, impacting millions of people working to sustain the flow of fresh-produce into supply chains -- **a mission essential to the health of all Americans.**

There is another reason contemporary EPA dietary and worker-safety risk assessments are almost certainly incorrect. Virtually all the science supporting current OP risk assessments conducted by EPA is based on studies and data on just the active ingredients in OP insecticides. But no OP is sold and sprayed as just pure active ingredient.

Many of the so-called “inert” ingredients in formulated OP insecticides are far from it. Some are toxic, volatile and markedly increase both dermal and inhalation exposures. In our comments we note that over decades of scientific assessments of OP use, exposures and risk, the often-sizable impacts of the inert ingredients in OP products have been largely ignored. This must change or OP use should come to an end.

We are virtually certain that EPA’s risk assessments of all the OPs that remain on the market are flawed because of failure to account for the added risks in formulated products compared to pure active ingredient. This is why a Heartland Health Research Alliance team published a paper⁵ in *Environmental Health* making the case for Congress to amend federal pesticide law to **require** pesticide manufacturers to clearly and accurately state on pesticide product labels all the chemicals in an end-use⁶ pesticide, as well as the concentrations of each chemical in the product.

Currently, the identity of “inert ingredients” is classified as “Confidential Business Information” and rarely disclosed. This keeps pesticide applicators, farmworkers, scientists not working for the pesticide industry, and the general public in the dark, since it is impossible to study or manage the adverse impacts of pesticides on people, babies, birds or bees without knowing what is in the products that are actually applied.

⁴ At various times the EPA refers to maximum dietary exposure thresholds as chronic Reference Doses, chronic Population Adjusted Doses, chronic Points of Departure, or chronic Benchmark Doses. The way the EPA utilizes toxicological test data varies across these different ways to estimate dietary exposure thresholds.

⁵ Benbrook C, Perry MJ, Belpoggi F, Landrigan PJ, Perro M, Mandrioli D, Antoniou MN, Winchester P, Mesnage R. Commentary: Novel strategies and new tools to curtail the health effects of pesticides. *Environ Health*. 2021 Aug 3;20(1):87. doi: 10.1186/s12940-021-00773-4. PMID: 34340709; PMCID: PMC8330079.

⁶ An “end-use” pesticide has been formulated to include needed adjuvants and surfactants and is typically ready to use as sold. End-use pesticides are often mixed with water prior to application.

3. Brief History of EPA's Regulation of OPs

This Section supports the Petition's request (I) to end EPA's unreasonable delay and expeditiously protect people, especially pregnant women, infants and workers, from OP exposures. The historical accounting provided illustrates the reasons that EPA action on remaining OPs is so long overdue.

The seminal NAS report *Pesticides in the Diets of Infants and Children* was released in 1993.⁷ It explains why prenatal and early life exposures to certain pesticides, such as chlorpyrifos and other OPs, posed neurodevelopmental risks that existing EPA toxicological test requirements and risk-assessment methods would likely not detect.

The Committee recommended a number of changes in EPA test protocols, science policies and risk-assessment procedures, as well as changes in the FIFRA statute and the Federal Food, Drug and Cosmetic Act (FDCA). The most consequential recommendations would direct EPA to:

- 1) Add an additional 10-fold safety factor in setting pesticide dietary risk thresholds (i.e. Population Adjusted Doses, Benchmark Doses) to account for the heightened vulnerability of pregnant women, infants and children;
- 2) Aggregate all exposures to a given pesticide across all possible routes of exposure (diet, drinking water and other beverages, dermal exposure, inhalation), and **assure that there is a "reasonable certainty of no harm" in the wake of estimated aggregate exposure;**
- 3) Assure that **cumulative exposures** across all pesticides that pose risks through the same mode of action meet the FQPA's safety standard (e.g. cholinesterase inhibition).

The Landrigan Committee highlights the need for better methods to investigate developmental neurotoxicity:

"Because neurotoxicity is such an important consideration for the newborn, EPA should continue to revise its published guidelines on developmental and functional neurotoxicity testing as new information emerges from the actual conduct of preregistration studies and from ongoing research in rodent neurotoxicity." (Page 155)

Passage and Impacts of the FQPA

The 1993 NAS report laid the foundation for needed changes in federal pesticide law. It helped to forge consensus around the core provisions in proposed legislation that had languished for nearly two decades. The FQPA was historic because it replaced the risk-

⁷ National Research Council (US) Committee on Pesticides in the Diets of Infants and Children. *Pesticides in the Diets of Infants and Children*. Washington (DC): National Academies Press (US); 1993. Accessible at <https://www.ncbi.nlm.nih.gov/books/NBK236275/>.

benefit balancing standard in FIFRA that had governed EPA tolerance setting and regulatory decisions for 24 years with a strictly health-based standard -- “reasonable certainty of no harm.”

The NAS report highlighted a number of pesticide-related reproductive and chronic disease risks, but focused on OP developmental neurotoxicity (DNT).

Why the deep concern in the early 1990s over the impact of OP exposures on children’s neural development? The first published papers reporting changes in the development of the brain in rat pups following prenatal exposure to the dam appeared in the mid-1970s. By the time the NAS Committee began its work in 1988, ***over 100 studies reporting similar neurodevelopmental impacts following pre-natal exposures to OPs, and especially chlorpyrifos, had been published in peer-reviewed journals.*** Today, the number exceeds 1,500.

Upon passage of the FQPA in the summer of 1996, 37 OPs held valid food use registrations and tolerances.⁸ There were 1,691 tolerances on the books covering OP residues in food, of which 109 covered chlorpyrifos residues. Across all pesticides, foods, and food forms in 1996, 9,721 tolerances were in need of reassessment. OPs accounted for 17% of all tolerances subject to review under the FQPA, but OPs accounted for a ***much larger share*** of total dietary risks, as we will show below.

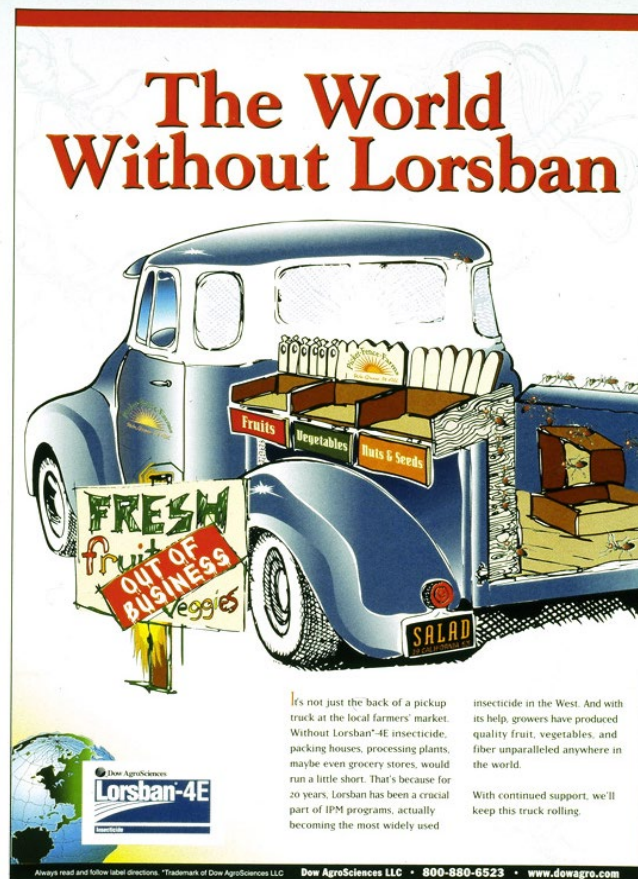
As the EPA worked to develop the science policies needed to implement the FQPA, predictions of dire consequences for farmers and the food supply became increasingly shrill. The advertisement pasted in below appeared in multiple farm and ranch magazines in the late 1990s and early 2000s.

The text of the “World Without Lorsban” ad warns:

“It’s not just the back of a pickup truck at the farmers’ market. Without Lorsban 4-E insecticide [chlorpyrifos], packing houses, processing plants, and maybe even grocery stores will run a little short.”

The suggestion that banning chlorpyrifos might lead to shortages of fruit and vegetables triggered substantial concern. Thousands of letters were sent to the EPA. This advertisement was a frequent topic of discussion among people working on FQPA implementation.

⁸ Minor differences occur in EPA reporting of the number of OPs and OP tolerances, as well as on the impacts of the FQPA. One cause of differences is whether OPs not registered in the US, but which have valid tolerances, are included in a particular accounting. Other differences arise from changes in the foods and/or food forms covered by a single tolerance.



A piece entitled “Growing Debate” in the *Los Angeles Times* (Martha Groves, July 12, 1998) begins with a fruit grower attesting to his need for OPs to control the Oriental fruit moth, but according to the piece:

“Come next year, under a sweeping new food safety law [the FQPA], the federal government might very well plow them [the OPs] under.”

The *LA Times* piece goes on to say “It is likely to mean unprecedented prohibitions against widely used pesticides...The environmental community says it will settle for nothing less, citing concerns that OPs can disrupt the brain development of fetuses and infants.”

EPA’s First Concrete Actions under the FQPA

The first concrete actions impacting the OPs were announced by then-EPA Administrator Carol Browner in an August 2, 1999 statement.⁹ It began by stating:

⁹ https://archive.epa.gov/epapages/newsroom_archive/speeches/2b597a262444a14f8525701a0052e341.html.

“In 1993, this Administration went to Congress with a plan -- based on recommendations from the National Academy of Sciences -- to better protect our children from the risks of pesticide residues in the fruits and vegetables they eat. Three years later that plan -- the Food Quality Protection Act -- passed Congress unanimously and was signed into law by President Clinton.

“Today -- after an extensive scientific review -- we are announcing the first major steps under this act that will safeguard our kids from two of the older and more widely used pesticides on the market. And that means greater protection for all of us.”

Administrator Browner then announced a voluntary cancellation agreement with registrants of methyl parathion, the most toxic of the 37 OPs then holding current registrations. According to the Administrator:

“The acute dietary risk to children one to six exceeded the acute population adjusted dose (or amount that can be consumed safely in one day or less) by 880%.”

Significant reductions in some azinphos methyl tolerances were announced,¹⁰ reducing future dietary exposures and risk from another OP used widely in tree-fruit production.¹¹ In her August 2, 1999 statement, the Administrator then adds an important challenge:

“Even as we begin to take specific actions on these chemicals, I am here today challenging the manufacturers of these older pesticide products to voluntarily come forward with the kind of risk reduction strategies similar to those we are announcing today.

“What’s important here is that in developing these new risk standards, for the first time we used children -- not the average adult -- as the benchmark for setting safety.”

“We often talk about the legacy each generation leaves for the generations to come. By ensuring the safety of the foods our children eat, we are helping create a healthier America now and for all the years to come.”

In response to these initial EPA actions targeted high-risk OPs, Consumers Union (CU) issued a statement criticizing the Agency for failing to act more comprehensively in light of the new mandates in the FQPA. Their report faulted the EPA for falling behind in the FQPA implementation schedule and for not addressing other major OP risk drivers, including chlorpyrifos, methamidophos and diazinon. CU then wrote:

¹⁰ In 1999 EPA revoked methyl parathion tolerances on children’s foods and markedly reduced several azinphos methyl tolerance, see https://archive.epa.gov/epapages/newsroom_archive/newsreleases/b2d9886ffa462c14852567c1005d263d.html

¹¹ Litigation filed by Earthjustice and other NGOs in 2004 challenged EPA’s decision to allow some continued crop uses of azinphos-methyl (AZM) on the basis of unreasonable worker risks. Court orders issued as a result of this litigation compelled EPA to more fully consider alternatives to AZM. This litigation lead over the course of five years to an EPA decision to phase out all uses of AZM by September 30, 2012.

“This afternoon, the EPA will claim that it has accomplished what the [FQPA] statute required it to do...Our analysis, released today, shows in sharp relief what the Agency hasn't done, what it could have done, and what it should have done.” (Emphasis in original; CU Statement, August 2, 1999, p. 1).

The detailed report released that day by CU was called *Worst First*.¹² (One of us, C. Benbrook, did the analysis and helped write the report). It showed that 125 pesticide-food combinations accounted for the lion's share of total pesticide dietary risk. OPs accounted for 19 of the top 30 pesticide-food combinations among the 125 worst-first food-pesticide combinations, **and a remarkable 89% of total risk**. According to the August 2, 1999 CU statement:

“Actually, a very small fraction of pesticide uses accounts for the lion's share of dietary residues and risk. Consumers Union's analysis shows that a mere 125 uses account for 99 percent of the dietary risk.”

The top 13 pesticide-food combinations in *Worst First* accounted for 72% of total risk across all food uses of pesticides. **So, the top 13 -- or 0.002% of 9,700 pesticide-food combinations covered by a tolerance -- accounted for almost three-quarters of total risk.**

The *New York Times* editorial page reacted to Administrator Browner's August 2, 1999 announcement in an editorial titled “Pesticides and Politics”:

“In 1996, in a rare display of bipartisanship and without a single dissenting vote, Congress passed the FQPA...Last week, Carol Browner, the EPA Administrator, fired her first shot...But it was merely the opening round in what is sure to be a long, politically charged regulatory struggle.”¹³

EPA took some important steps in 2002-2004 that resulted in reducing OP use and dietary exposures, although by modest amounts compared to the initial actions impacting the parathions, azinphos methyl, and chlorpyrifos.

Almost 20 years passed before the next major step in reducing OP use and risks. It was triggered by actions taken by California Department of Pesticide Regulation (DPR). In October 2019 DPR announced an agreement with Corteva (the new company formed out of the merger of Dow and DuPont) to end all sales of chlorpyrifos in California as of February 6, 2020.¹⁴ In its press release, DPR stated that “The swift end to the sale of chlorpyrifos products protects vulnerable communities by taking a harmful pesticide off the market.” The DPR-CalEPA press release cites “mounting evidence...of serious health effects in children...**including impaired brain and neurological development.**”

Soon thereafter, the EPA started the process required to phase out and revoke all remaining tolerances allowing chlorpyrifos food uses. The agency acted under pressure

¹² Accessible at <https://advocacy.consumerreports.org/wp-content/uploads/2013/04/worst1st.pdf>.

¹³ NY Times, August 9, 1999, <https://www.nytimes.com/1999/08/09/opinion/pesticides-and-politics.html>.

¹⁴ <https://www.cdpr.ca.gov/docs/pressrls/2019/100919.htm>.

from the 9th Circuit Court of Appeals stemming from a lawsuit filed by environmental, consumer and farmworker non-profits in 2007.¹⁵

The end of chlorpyrifos use on food crops was driven by the EPA's years-long reassessment of the risks arising from chlorpyrifos's developmental neurotoxicity following prenatal exposures. Under the FQPA, EPA must determine before reregistering a pesticide that current levels of dietary exposure to the pesticide are compatible with the FQPA's "reasonable certainty of no harm" standard. **And it must do so based on credible science and evidence.** In the case of chlorpyrifos by the end of 2014, EPA could not make this determination and so, under the law, the tolerances had to be either revoked or lowered to a "safe" level (i.e. one that meets the FQPA's "reasonable certainty of no harm" standard). The lowering of tolerances sufficient to avoid neural developmental risk was not an option because tolerances low enough to mitigate excessive risks would require changes in how the insecticide could be used that would render it ineffective for intended uses.

4. Critical Impacts of EPA Largely Ignoring the Inert Ingredients in OP Formulations

*Here we highlight a glaring inadequacy in all existing EPA human-health risk assessments on OP insecticides – **failure to account for how the "inert" ingredients in OP products increase exposures and risk levels.***

Publicly available information on the specific inert ingredients in OP insecticides is limited, but still strongly supports the likelihood that formulated OP products pose substantially greater risks than pure active ingredients, **especially via the inhalation and dermal routes of exposure.** Farmworkers and applicators almost certainly bear the brunt of such risks.¹⁶ This lingering blind spot in EPA human-health risk assessments on individual OPs supports the Petition's request that EPA cancel registrations of the remaining OP uses without delay.

Pesticide products typically contain adjuvants and surfactants mixed into formulations to enhance product efficacy. "Surfactant" is short for "surface-acting-agent." These chemicals reduce the surface tension of liquids and enhance stickiness of pesticides, including the OPs, on plant leaves.

These "inert" coformulants are "inert" only in terms of **not** contributing to the pesticidal claims made by registrants. Pesticide manufacturers can classify coformulants as "inert

¹⁵ The original petition was filed by the Pesticide Action Network and NRDC.

¹⁶ The failure of the FIFRA statute and EPA's regulatory process and framework to fully understand, quantify, and effectively mitigate such worker risks is one of the pressing, ag-centric social justice and public health issues in need of action by both the Executive Branch and Congress.

ingredients” even when they are toxic or substantially alter the risks associated with a given formulated product.¹⁷

Federal pesticide law allows pesticide manufacturers to classify the identity and concentrations of inert ingredients in specific formulated products as “Confidential Business Information” (CBI), and hence shields these ingredients from disclosure on pesticide labels. This is why farmers, applicators and scientists outside the industry generally have no way of knowing what is in a formulated OP insecticide.

Over many years of intense scrutiny worldwide on the health risks stemming from OP uses and exposures, almost no attention in the scientific, public health or agricultural communities has been directed at how the inert ingredients in OP formulations alter exposure and risk profiles. The same is true of physicians treating OP-poisoning victims.

The last widely used chlorpyrifos formulation sold in the US was Lorsban Advanced. It was launched nationwide by Dow Agrosiences (DAS) in 2009. Lorsban Advanced was described by the company as a new low-odor, water-based full-service liquid insecticide. The new formulation could be used on all crops previously treated by Lorsband-4E, and at roughly the same rates of application.

The May 15, 2015 Lorsban Advanced Material Safety Data Sheet (MSDS) issued by DAS discloses the composition of Lorsban Advanced:

- | | |
|---|-------|
| • Chlorpyrifos | 44.9% |
| • 2-Ethylhexanol | 1.0% |
| • Solvent naphtha (petroleum), light aromatic | 48.6% |
| • Other ingredients | 5.5% |

Based on the disclosed ingredients and concentrations on the Lorsban Advanced MSDS, ***the specific chemical composition of less than one-half of the ingredients in the formulation is disclosed.***

The generically described “Solvent naphtha” fraction accounts for a higher percentage of the formulated product than chlorpyrifos. While scant information is available publicly on the actual contents of this solvent fraction, EPA documents make clear that it is composed of highly volatile compounds, some of which are likely neurotoxic and/or carcinogenic. The impact of these solvents on human reproduction and children’s development may be significant, but to our knowledge, ***EPA has never required OP registrants to conduct a single developmental neurotoxicity study with formulated products as sold and applied by farmers and other pest managers.***

¹⁷ “Inert ingredients” are evaluated to a certain extent by regulators. There is a list of generally acceptable inert ingredients maintained by EPA, but EPA rarely requires ***chronic tests of the mixtures of inert ingredients and active ingredients in pesticide products as sold and applied.*** Mixtures of chemicals can pose risks not evident in toxicological experiments carried out on the individual chemicals in the mixture.

This is an especially major shortcoming in the case of OPs. These and related solvents pose many risks. A study suggested that *in utero* exposure to benzene, ethyl-benzene, and xylenes from air pollution increases risks for developing autistic disorder.¹⁸ Another recent study showed that the use of petroleum distillates as pesticides increases the risk of developing a genetic abnormality called monoclonal gammopathy of undetermined significance, a precursor of the cancer multiple myeloma.¹⁹

If the EPA chooses to leave any OP uses on the market, it will be essential for the agency to carry out a rigorous assessment of the impacts of OP “inert ingredients” on product safety. To do so, it will take 3-5 years and hundreds of millions of dollars for the industry to conduct EPA-required tests. It will then take another 2-3 years to evaluate the results and decide upon necessary risk-mitigation measures. And then, some OP registrants will likely contest the EPA’s updated risk assessments, so another 3-10 years will lapse to litigate and resolve various scientific issues before meaningful change is made to reduce OP risks.

Does it really make sense to devote the public and private resources needed to fully understand and mitigate the public health impacts of the coformulants in OP insecticides over the next 8-18 years? We think not and hope the EPA and stakeholders agree.

5. Existing OP Benchmark Doses, cPADS and cRfDs

This Section of our comments directly supports Parts I and III of the requests advanced by Petitioners. The data presented illustrates the importance and consequences of basing OP regulatory thresholds on neurodevelopmental toxicity instead of cholinesterase inhibition.

EPA continues to regulate all OPs except chlorpyrifos on the basis of cholinesterase inhibition when it is virtually certain all OPs should be regulated on the basis of developmental neurotoxicity. For this reason alone, the full FQPA 10-fold safety factor should be applied to all OPs.

The EPA was able to develop a sophisticated and rigorous method to base chlorpyrifos regulation on developmental neurotoxicity because of a unique combination of circumstances. In particular, the banning of chlorpyrifos uses inside homes and buildings

¹⁸ von Ehrenstein, O. S., Aralis, H., Cockburn, M., & Ritz, B. (2014). In utero exposure to toxic air pollutants and risk of childhood autism. *Epidemiology* (Cambridge, Mass.), 25(6), 851–858. Accessible at <https://doi.org/10.1097/EDE.0000000000000150>.

¹⁹ Hofmann JN, Beane Freeman LE, Murata K, Andreotti G, Shearer JJ, Thoren K, Ramanathan L, Parks CG, Koutros S, Lerro CC, Liu D, Rothman N, Lynch CF, Graubard BI, Sandler DP, Alavanja MC, Landgren O. Lifetime Pesticide Use and Monoclonal Gammopathy of Undetermined Significance in a Prospective Cohort of Male Farmers. *Environ Health Perspect*. 2021 Jan;129(1):17003. doi: 10.1289/EHP6960. Epub 2021 Jan 6. Accessible at <https://europepmc.org/article/med/33404262>.

in 2001 created an opportunity for epidemiologists to quantify the risks arising from prenatal exposures during and after a period when chlorpyrifos was used widely in large apartment buildings. Published epidemiology studies showed clearly that even low levels of exposure to chlorpyrifos, as measured in the blood of pregnant women, were associated with increased risk of developmental abnormalities.

The EPA, scientists outside the government and industry, and multiple Scientific Advisory Panels worked over several years to refine the methods EPA was developing to base chlorpyrifos dietary risk assessments on neurodevelopmental outcomes. Doing so based on the results of an epidemiological study in a population of pregnant women was an important scientific and regulatory achievement that has withstood intense criticism from OP registrants, industry allies in academia, and the pesticide industry and farm organizations.

The outcome of EPA's multi-year effort to develop a method to use the results of an epidemiology study to set the acute DNT "Steady State aPAD"²⁰ (acute Population Adjusted Dose) for chlorpyrifos is shown in Table 1. The huge drop in the basis for regulating chlorpyrifos dietary exposures drives home how important it is to regulate all remaining OPs on the basis of developmental neurotoxicity.

In the EPA's 2011 chlorpyrifos human-health risk assessment (EPA "HHRA", not the HHRA non-profit submitting these comments), the Agency acknowledged that both its scientists and the SAP were convinced that prenatal chlorpyrifos exposures raised the risk of DNT in young animals (including humans). In the 2014 chlorpyrifos HHRA, the EPA and the SAP further concluded and stated that chlorpyrifos poses a risk of developmental neurotoxicity in humans at dose levels below those necessary to trigger 10% or more AChE inhibition, then the basis of chlorpyrifos regulation.

²⁰ The EPA describes a "Steady State aPAD" for an OP in a Federal Register notice (<https://www.federalregister.gov/documents/2015/11/06/2015-28083/chlorpyrifos-tolerance-revocations>): "After repeated dosing at the same dose level, the degree of [cholinesterase] inhibition comes into equilibrium with the production of new, uninhibited enzyme. OP AChE studies of 2-3 weeks generally show the same degree of inhibition as those of longer duration (i.e., up to 2 years of exposure). Therefore, a steady state assessment based on 21 days of exposure may be conducted in place of the traditional chronic assessment).

	1970s	Early 1980s	1996	2000	2011	2014	2016	2020
Acute Dietary								
Basis	AChE	AChE	AChE*	AChE	ACHE	AChE	DNT	AChE
NEL/NOAEL/BMD/POD (mg/kg/day)	0.1	0.1	0.03	0.5	0.36	0.099	0.00017	0.099
Interspecies SF	10	10		10	10	0	0	0
Intraspecies SF			10	10	10	4	10	4
FQPA SF				10	1	10-X	10**	10-X
Total Safety Factor	10	10	10	1,000	100	40	100	40
ADI or aRfD	0.01	0.01	0.003	0.005	0.0036			
aPAD				0.0005	0.0036	0.015	0.0000017	0.015
Steady State aPAD						0.0025	0.0000017	0.0025
Dietary Exposure								
Most Sensitive Cohort	NS	NS	Infants < 1	Children 1-6	Children 1-2 year	Children 1-2 year	Children 1-2 year	Children 1-2 year
Food Intake (mg/kg/day)	0.04	0.010	0.00215	0.00041	0.000323	0.000242	0.000242	0.000242
% Risk Cup	40%	~100%	71.6%	82%	9%	9.7%	14000%	9.7%
Notes:								
* The AChE NOAEL in 1996 was based on a Dow study in human volunteers, (Coulston et al., 1972)								
** The second 10-X safety factor imposed was justified by the lack of a NOAEL for AChE in a DNT study, and so is not technically an FQPA safety factor.								
NS = Not Specified								

Under standard EPA policy, this finding should have triggered in 2014 a shift from regulating chlorpyrifos on the basis of AChE inhibition to regulation based on DNT. But as explained in the 2014 chlorpyrifos HHRA, the EPA lacked a method to establish a chlorpyrifos acute Point of Departure (aPOD) based on DNT.

The SAP had suggested a way to establish a DNT aPOD based on the results of published epidemiological studies. The EPA continued work and established in 2015 what the Agency regarded as a sound basis for identifying a chlorpyrifos aPOD/aPAD based on DNT. The intraspecies 10-X safety factor was retained and the 10-X interspecies safety factor was dropped, since the DNT aPOD was based on human data derived from a Columbia University epidemiology study. An additional 10-X safety factor was added, justified by a combination of the FQPA and the absence of a NOAEL in the chlorpyrifos DNT study.

These parameters led to a new chlorpyrifos, DNT-based steady-state aPAD of 0.0000017 mg/kg/day, **a 1,470-fold reduction** from the 0.0025 mg/kg/day steady state aPAD set as part of the 2014 HHRA.

With such a low steady state aPAD, the EPA’s “highly refined” estimate of dietary exposure among children 1 to 2 years of age **filled the chlorpyrifos risk cup 142-times over**. As a result, the EPA initiated cancellation of all chlorpyrifos tolerances.

The EPA lacks high-quality DNT studies on many of the remaining OPs conducted by scientists independent of OP registrants. There are no epidemiological studies on other OPs comparable to the chlorpyrifos epidemiological studies used in setting the chlorpyrifos aPOD. But the results of multiple animal studies indicate that all or most OPs pose risk of DNT and there is no basis or reason to presume that among the OPs, chlorpyrifos is uniquely potent in its ability to disrupt neurodevelopment.

If the EPA, pesticide manufacturers, and the scientific community invest the time (many years) and resources (over \$80 million)²¹ required to develop high-quality DNT and epidemiological data across all the remaining OPs, it is likely that the aPODs for other OPs will have to be reduced by at least an order of magnitude, and possibly by 100-fold or more. After such reductions, few if any food uses of any OP would be consistent with the FQPA’s “reasonable certainty of no harm” standard. **Instead, the science will likely point to significant risk of reproductive and developmental harm impacting possibly millions of newborns every year.**

6. Dietary Exposures to OPs

Part II of Petitioner’s request calls for the revocation of tolerances and cancellation of registrations for OPs that pose dietary risks of concern. Heartland Health Research Alliance (HHRA) analyses of OP residues in food and associated risk levels show that hundreds of millions of servings of food each year in the US contain OP residues above EPA’s “level of concern.” Moreover, imported fruits and vegetables account for a significant and growing share of food with worrisome levels of OP residues. Until the hundreds of tolerances sanctioning OP residues in food are revoked, imported food will pose an increasingly erratic risk of excessive dietary exposures to OPs.

Scientists affiliated with HHRA have decades of experience in assessing dietary exposures to OP insecticides. We have developed a Dietary Risk Index (DRI) system that quantifies pesticide dietary risks by food-pesticide combinations. The methodologies and data used to compute DRI risk levels are similar to those relied on by EPA and are described in published papers that will be submitted to the docket as part of these comments.²²

²¹ Two new epidemiological studies on ~15 OPs at an average cost of \$2 million/study (\$60 million); one or two new DNT studies per OP (~\$20 million).

²² The primary methods paper is Benbrook, Charles M., & Davis, Donald R.; “The dietary risk index system: a tool to track pesticide dietary risks,” *Environmental Health*, 2020, 19(1); DOI: 10.1186/s12940-020-00657-z. The individual sample methodology paper is Benbrook, C. “Tracking pesticide residues and risk levels in individual samples—insights and applications,” *Environ Sci Eur* 34, 60 (2022). <https://doi.org/10.1186/s12302-022-00636-w>

The DRI system calculates relative dietary risk levels in food-pesticide combinations based on each pesticide's chronic Reference Dose (cRfD) or chronic Population Adjusted Dose (cPAD) as set by EPA. Residue and food-serving size data come from the USDA. There are three basic DRI metrics, each calculated as a ratio of dietary intake of a pesticide compared to the EPA-set, maximum acceptable daily intake of the pesticide. Two of the three DRI metrics are based on the mean of the positive samples of a given food and pesticide in a year of testing:

DRI-M Positive Sample Mean DRI = $(\text{Mean of Pos Residues} \times \text{Serv}) / (\text{cRfD} \times \text{BW})$

FS-DRI Food Supply DRI = $\text{DRI-M} \times \% \text{Positive}$

Where "Serv" is the typical single-serving size of the food for a 4-year old child in grams, and "BW" is bodyweight in kilograms.

For each individual sample tested by the US-PDP or UK-Food Standard Agency (UK-FSA), and for each residue reported in an individual sample:

Individual Sample DRI = $(\text{Pesticide concentration} \times \text{Serv}) / (\text{cRfD} \times \text{BW})$

Any individual sample of a food-pesticide combination with a DRI value > 1 suggests that a single serving of the food contains more pesticide than the cRfD/cPAD/aPAD would allow for a 4-year old -- **and hence triggers EPA's "level of concern."** Any DRI-Mean or FS-DRI value over 0.1 is of concern and warrants monitoring, because these metrics are driven by the mean of the positive residue levels, and for most food-pesticide combinations, some individual-sample residues exceed the mean of the positives by a factor of 10 or more.

The USDA's Pesticide Data Program (PDP) tested 14 foods in 1996. Across these foods, there were 2,200 samples with OP residues as shown in Table 2. Aggregate OP Food Supply (FS)-DRI in 1996 was well above the level which should trigger EPA's "level of concern" for hundreds of samples, based on the level of OP residues in individual samples of several foods.

	Samples Tested	Number of Positives	Percent Positive	FS-DRI	Share of Total FS-DRI
Parathion-methyl	1,672	134	8%	0.783	33%
Methamidophos	2,159	241	11%	0.571	24%
Chlorpyrifos	3,365	344	10%	0.215	9%
Acephate	2,291	199	9%	0.215	9%
Azinphos-methyl	2,542	304	12%	0.154	6%
Chlorpyrifos methyl	340	249	73%	0.135	6%
Phosmet	1,411	111	8%	0.091	4%
Parathion-ethyl	761	4	0.5%	0.090	4%
Dimethoate	2,742	132	5%	0.037	2%
Other OPs	12,321	482	4%	0.104	4%
Total Positives and Aggregate DRI	29,604	2,200		2.396	100%

The DRI system can be used to track changes in OP residues and DRI-risk levels over time. Table 3 shows changes in aggregate DRI risk levels from a pre-FQPA baseline in 1995 to 2005, after the first set of major actions taken by EPA to reduce OP dietary risk levels. Changes from 2005 to 2015 and to 2020 are also shown, as well as percent changes from the pre-FQPA baseline to 2015. For 1995, 2005, and 2015, Supplemental Tables 7-9 contain the data by crop used to generate Table 3.²³

In assessing the results in Table 3, it is important to note that the PDP tests a different set of foods and food forms every year. In some years they select and test several fresh fruit and vegetable crops, including some like green beans, apples and peaches that typically are found to contain residues of several OPs. Such years tend to be associated with relatively high aggregate-OP DRI values. In other years, the PDP tests fewer fruits and vegetables and/or fewer crops that usually contain relatively high OP residues. Nonetheless, the data in Table 3 provides a useful overview of how EPA actions and the FQPA has reduced OP dietary risks over time. The metrics in Tables 3 and 4 include "Average per Crop Tested." This DRI-Mean and Food Supply-DRI metric helps correct for variation in the number of foods tested by the PDP from year to year.

DRI-Mean values can be very high for a crop on account of a single or very few samples with high levels of a toxic pesticide, but no other samples with lower levels of residues (hence, the few relatively high residues result in a high mean-of-the-positive value, and

²³ The data for 2020 in Tables 3 and 4 are from the DRI system and is accessible at hh-ra.org/dietary-risk/index.

hence a high DRI-Mean). In such cases, the Food Supply-DRI levels are much lower and provide a more accurate estimate of average or typical residue levels, frequency of exposures, and risk levels. For example, consider the big increase to 69.9 in the all-crop, aggregate DRI-Mean value in 2020 in Table 3.

Table 3. Changes in OP Dietary Risk Levels from the Pre-FQPA Baseline in 1995 to 2005 and 2015: Domestically Grown, Conventional Samples Tested by the USDA's Pesticide Data Program

	1995	2005	2015	2020	Percent Change from 1995 to 2020
<u>All Crops Tested by the PDP</u>					
Number of Foods	11	23	19	16	
DRI-Mean	32.8	18.4	21.9	69.9	113%
Food Supply-DRI	2.11	2.07	0.83	0.88	-58%
<u>Average per Crop Tested</u>					
DRI-Mean	2.98	0.80	1.15	4.37	47%
Food Supply-DRI	0.192	0.090	0.0437	0.055	-71%

The big increase in DRI-M across all crops tested in 2020 is brought about largely by just 7 samples of two foods. One sample of green collards out of 426 contained diazinon at 2.1 ppm, leading to a DRI-M of 38. Acephate was found in 2 of 106 samples of green beans at 5.6 ppm, accounting for a DRI-M value of 20.8. Methamidophos was detected in 4 out of 106 samples of green beans, resulting in a DRI-M of 8.8. These 7 samples account for total DRI-M of 65.2, or 93% of the total DRI-M of 69.9 in that year of PDP testing for OPs across 16 foods. A relatively few samples also account for the majority of OP-driven aggregate DRI-M in most other years of PDP testing.

This finding drives home the reality that in 2005, farmers still had the option of using several OPs. To this day, a small number of acres of fruit and vegetable crops are still being treated with high-risk OPs. ***This is among the key reasons we support revocation of all remaining OP food use tolerances.***

There is a positive flip-side to the fact that a relatively few PDP samples account for most of the risk each year. It also means that the vast majority of samples and servings of fruits and vegetables pose low, or essentially no known risk from pesticide residues. But a single PDP sample of widely consumed fruits and vegetables like apples, strawberries, lettuce,

tomatoes, and potatoes is representative of millions of servings. Moreover, it is unlikely the highest-risk sample of any food tested by the PDP is, in fact, the highest-risk sample.

FS-DRI levels across all crops tested declined by about one-half from 0.192 in 1995 to 0.09 in 2005, and then again by about one-half, to 0.0437 by 2015. From 1995 to 2020 the level per crop tested fell by 71%. Given that the data in Table 3 predates the end of chlorpyrifos food uses, the trend toward lower DRI values stemming from OP residues has likely continued.

In domestically grown food, we are confident that overall OP dietary risk levels in the American food supply in 2022 have been reduced markedly compared to the pre-FQPA baseline. However, we remain concerned about the level and trends in OP residues and risk in imported foods.

Table 4 reports changes in DRI levels from 1995 to 2005 to 2015 and 2020 for all residues detected by the PDP in imported foods. In the case of all-crop aggregate DRI-Mean since 2005 and FS-DRI since 1995, the DRI-Mean and FS-DRI levels stemming from OP residues have trended downward. The steady decline in average FS-DRI per food tested – and the 91% overall reduction – is encouraging. However, as shown in Table 5, OP risk levels in some imported foods have risen in the last 15 years.

Table 4. Changes in OP Dietary Risk Levels from the Pre-FQPA Baseline in 1995 to 2005 and 2015: Imported Conventional Samples Tested by the USDA's Pesticide Data Program

	1995	2005	2015	2020	Percent Change from 1995 to 2020
<u>All Imported Crops Tested by the PDP</u>					
Number of Crops	8	14	16	17	
DRI-Mean	8.0	18.0	24.5	4.51	-44%
Food Supply-DRI	1.12	1.17	0.73	0.225	-80%
<u>Average per Imported Crop Tested</u>					
DRI-Mean	1.0	1.29	1.53	0.265	-74%
Food Supply-DRI	0.14	0.084	0.046	0.0132	-91%

In Table 5, we present a comparison of FS-DRI values in four widely consumed fruits and four vegetables. The table is constructed to compare the trend in FS-DRI by food in

domestically-grown produce compared to imported produce. In the case of the four fruits, FS-DRI values dropped 85% from the pre-FQPA baseline era to the most recent year a given crop was tested by the PDP. Over this approximate-25 year period, the FS-DRI value dropped 85% or more in three of the domestically fruits, but rose 7% in cherries. In the case of the imported fruit samples, the FS-DRI level went up in two crops and fell in three, but to a much lesser extent than in the corresponding domestically grown fruit. Averaged across the four fruits, the OP residues in domestically grown fruit were associated with FS-DRI values 85% lower than the average in 1995. The corresponding reduction in imported fruit was 29%. In all four fruits, the FS-DRI value in 2020 was higher in the imported fruit compared to the domestically grown fruit. In 1995, the opposite was true – the FS-DRI values in imported fruit were all lower than in the domestically grown fruit.

Table 5. Changes in FS-DRI Values for Selected Domestically Grown and Imported Fruits and Vegetables: Pre-FQPA Baseline, Mid-2000s, and Recent Year PDP Testing (see notes)

	Pre-FQPA Baseline		Mid-2000s		Most Recent Year Yested		% Change Most Recent Year to FQPA Baseline	
	Domestic Samples	Imported Samples	Domestic Samples	Imported Samples	Domestic Samples	Imported Samples	Domestic Samples	Imported Samples
Fruits								
Peaches	2.283	0.753	0.401	0.830	0.232	0.339	-90%	-55%
Strawberries	0.905	0.572	0.284	0.276	0.126	0.843	-86%	47%
Grapes	0.749	0.303	0.897	0.175	0.034	0.056	-95%	-82%
Cherries	0.202	NA	0.063	0.128	0.216	0.305	7%	139%
Average 4 Fruits	1.035	0.543	0.411	0.352	0.152	0.386	-85%	-29%
Vegetables								
Spinach	0.174	0.069	0.091	0.070	0.338	0.282	94%	307%
Green beans	0.595	0.043	1.465	0.230	0.724	0.159	22%	267%
Tomatoes	0.381	0.388	0.084	0.190	0.021	0.011	-94%	-97%
Potatoes	0.142	0.042	0.157	0.122	0.224	0.160	57%	279%
Average 4 Vegetables	0.323	0.136	0.449	0.153	0.327	0.153	1%	13%

Notes:

1. Pre-FQPA baseline samples were tested in 1993 to 2000.
2. Mid-2000s samples were tested in 2005 to 2008.
3. Most Recent Year samples were tested in 2015 to 2020.
4. The imported cherries percent change is from 2007, the first year imported cherries were tested by the PDP.

FS-DRI trends in these four vegetables are more erratic. In three of the four crops, FS-DRI values have risen since 1995 in both domestic and imported vegetables. But FS-DRI levels have increased much more dramatically in imported vegetables. Still, FS-DRI values in all

four vegetable crops were still lower in 2020 than the corresponding FS-DRI values in domestically grown vegetables. Steady and sizable reductions in OP residues and FS-DRI risk levels in both domestic and imported tomatoes is a welcomed exception to generally rising OP FS-DRI levels in spinach, green beans, and potatoes.

OP Risk levels in Individual Samples

Despite heavy investments by the EPA, USDA, and industry in generating data needed to conduct pesticide dietary-risk assessments, very few independent analyses have been undertaken of the levels and distributions of dietary risks across: foods, pesticides, the source of food (domestically grown or imported), and farm production systems (e.g. conventional, organic). The way EPA conducts pesticide dietary-risk assessments and reports results does not lend itself to analysis of overall pesticide dietary-risk levels or relative risks across foods and pesticides, nor changes over time.

Critically, EPA dietary risk assessments do not support assessments of the distribution of risk levels associated with a given pesticide in a specific food. This gap in pesticide dietary risk-assessment capability is a serious one because year-to-year, very few pesticides, including several OPs in relatively few foods, account for a large share of overall pesticide dietary risk.

HHRA has analyzed the levels of OP risk in individual samples of food tested by both the US-PDP and the UK-FSA. Any individual sample with a single-pesticide-food DRI value greater than 1 exceeds EPA's "level of concern". We regard DRI values between 1 and 10 to be "High" risk, and levels greater than 10 to be "Very High" risk samples. Recall that the FQPA requires the EPA to assess aggregate exposures to each OP from all food uses, drinking water and beverages. When a single serving of one food fills an OP's entire risk cup²⁴, the EPA's "level of concern" is more than met.

Plus, the FQPA requires EPA to assess *cumulative exposures across all OPs*, and assure that cumulative exposures do not fill the overall OP risk cup. This is why an *individual sample of one food* should not come close to filling any OP risk cup.

Unfortunately every year, millions of individual servings of food contain OP residues that are associated with a DRI value greater than 1. Table 6 below identifies 205 samples of individual foods tested by the USDA's PDP from 2016-2020 that contained an OP residue with a DRI value greater than 1, or on average 41 samples per year.

On average annually across the US population in any given year of PDP testing, each sample of a commonly consumed food tested by the PDP represents the likely residues

²⁴ When a residue of a pesticide in a single serving of one food results in the maximum allowed daily exposure to that pesticide, the residue "fills" the pesticide's "risk cup" and triggers EPA's "level of concern".

and risks associated with about 10 million servings of the food. Hence, 41 OP residues per year associated with a DRI greater than 1 suggest that some 400 million servings of food contain OP residues unambiguously over the EPA’s “level of concern.” In addition, this estimate of 400 million servings in a year is based on just the portion of the total food supply covered by PDP testing in 2016-2020, since the PDP tests only 10-15 foods per year. If OP residue data were available across the whole food supply, there would surely be over a billion servings of food annually with an OP residue over EPA’s “level of concern.”

Table 6. Pesticides Associated with High and Very High Risk Samples in US PDP Testing 2016-2020

Pesticide	Number of Samples	Percent of All Samples	Family of Chemistry
Methamidophos	60	15.0%	OP
Dieldrin	58	14.5%	
Famoxadone	44	11.0%	
Chlorpyrifos	41	10.3%	OP
Acephate	38	9.5%	OP
Oxydemeton methyl	31	7.8%	OP
Oxamyl oxime	22	5.5%	
Dimethoate	15	3.8%	OP
Cyhalothrin, Total	11	2.8%	
Emamectin benzoate	9	2.3%	
Diazinon	6	1.5%	OP
Cyhalothrin, Lambda	6	1.5%	
Oxamyl	6	1.5%	
Tolfenpyrad	5	1.3%	
Cyantraniliprole	5	1.3%	
Dichlorvos (DDVP)	5	1.3%	OP
Methomyl	5	1.3%	
Dicloran	4	1.0%	
Fipronil	3	0.8%	
Monocrotophos	3	0.8%	OP
Fenamidone	3	0.8%	
Formetanate HCL	2	0.5%	OP
Bifenthrin	2	0.5%	
Fludioxonil	2	0.5%	
Cymoxanil	2	0.5%	
Pyraclostrobin	2	0.5%	
Tricyclazole	1	0.3%	
Carbaryl	1	0.3%	
Carbofuran	1	0.3%	
Chlorothalonil	1	0.3%	
Profenofos	1	0.3%	OP
Triflumizole	1	0.3%	
Phorate.sulfoxide	1	0.3%	OP
Oxydemeton methyl sulfone	1	0.3%	OP
1-Naphthol	1	0.3%	
Omethoate	1	0.3%	OP
Totals	400	100%	
Number OP Residues	205		
OP Residues as % of Total	51%		

7. Trends in OP Use

OP use has declined steadily for over 20 years. Data cited in Section 7 on declining reliance on OPs, coupled with our comments in Section 8 on alternatives to OPs, strongly support the Petitioners' request for timely action in revoking all OP tolerances.

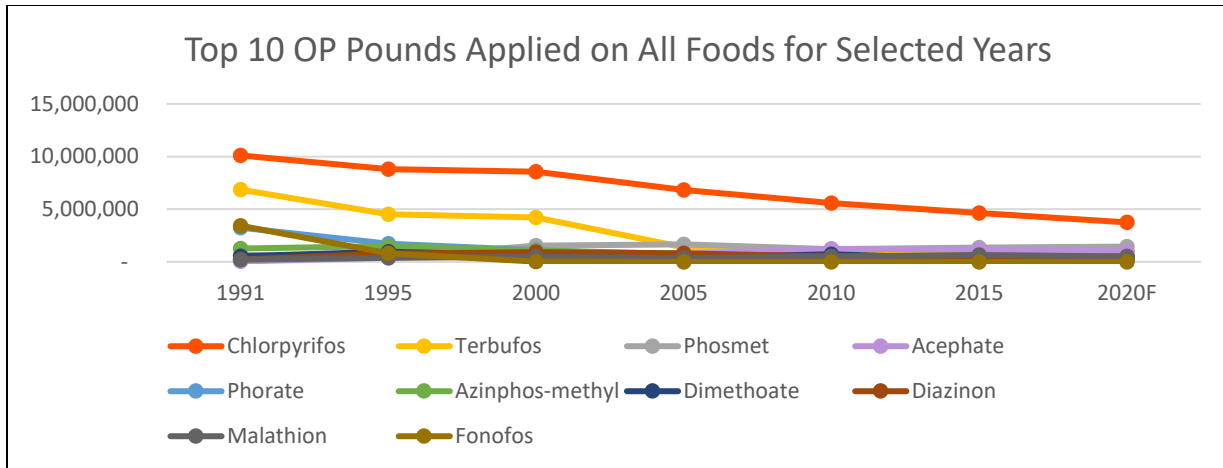
The Pesticide Use Data System (PUDS) draws on the annual pesticide use data compiled by the USDA. The use data from each annual USDA survey is moved into a relational database. The PUDS supports analyses of differences across space (i.e. California versus Iowa) and changes over time in pesticide use and reliance. The methodology and data in PUDS are explained on Hygeia Analytics at <https://hygeia-analytics.com/pesticides/usage/puds-the-pesticide-use-data-system/>.

The interactive, online tables generated by PUDS are accessible at <https://hygeia-analytics.com/tools/puds/by-crop/>.

By any measure, OP use has sharply declined since passage of the FQPA in 1996. Farmers have found effective and affordable alternatives, and many growers have made significant progress in adoption and refinement of prevention-based bio-IPM. Today, nearly 10% of fresh fruits and vegetables are grown on organic farms that use essentially no synthetic pesticides and rely predominantly on multi-tactic, non-chemical control strategies.²⁵

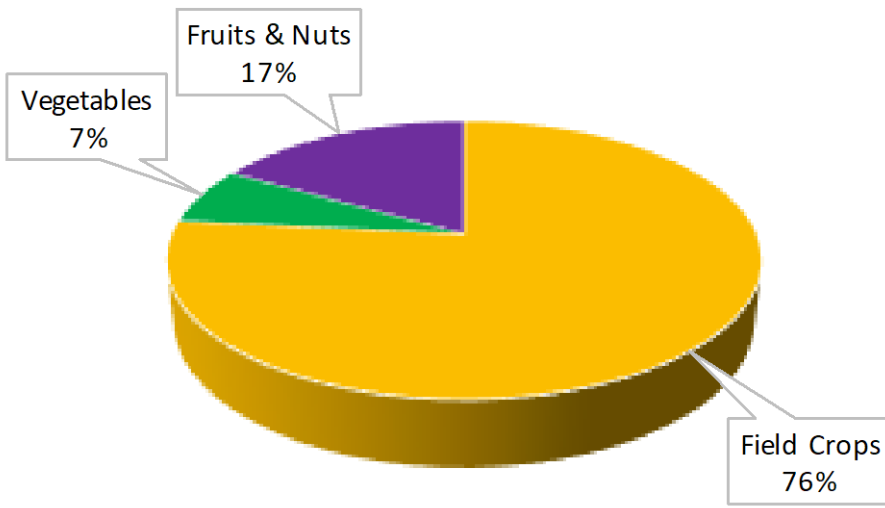
The below figure displays trends in the agricultural use of major OPs from 1991 to 2020 (estimated for some crops/years). Corn continues to account for the largest share of total OP use as shown in multiple tables and figures.

²⁵ For details on the impact of organic farming on pesticide use and dietary risks, see Benbrook, Charles, Kegley, Susan, & Baker, Brian; "Organic Farming Lessens Reliance on Pesticides and Promotes Public Health by Lowering Dietary Risks;" *Agronomy*, 2021, 11(7); DOI: 10.3390/agronomy11071266.



The three figures below provide an overview of the share of total OP use in 1995, 2005 and 2015 applied on different types of crops. Row crops, and particularly corn, accounted for 76% of total OP use in 1995, falling to 75% and 60% in 2005 and 2015. The share of total OP use on fruit and nut crops rose from 17% to 33% from 2005 to 2015, despite substantial reductions in OP use on fruit and vegetable farms.

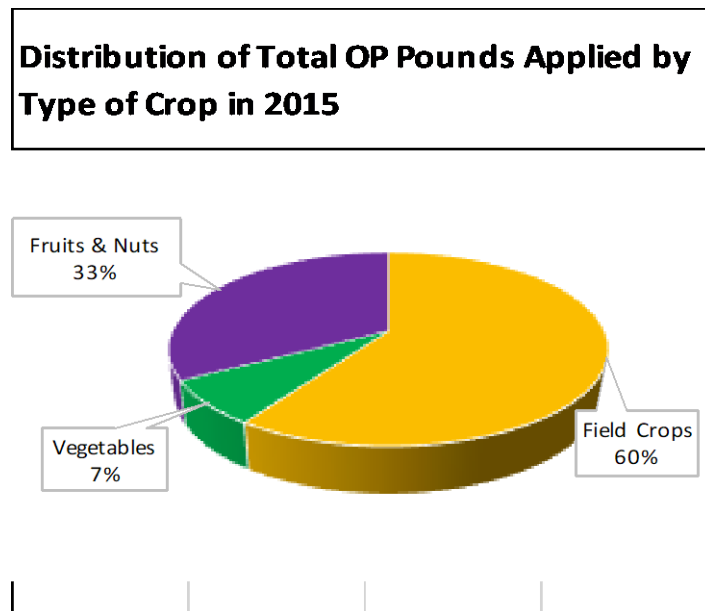
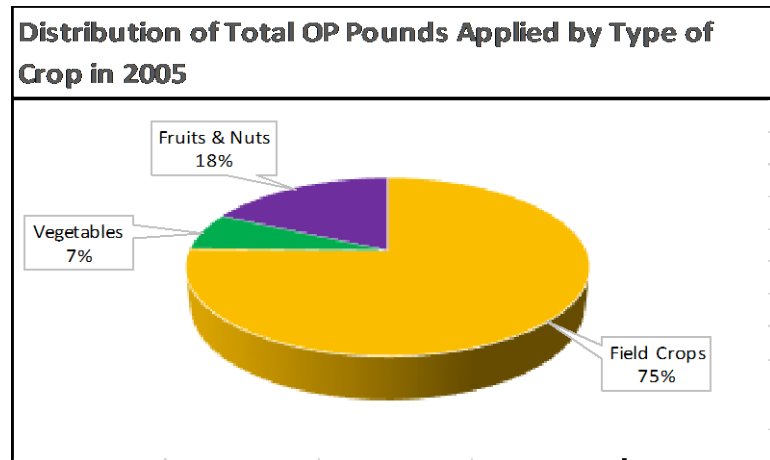
Distributuion of Total OP Pounds Applied by Major Crop Type in 1995



Data on total OP use by crop and type of crop from the PUDS was used to generate the above figures. These data can be found in Supplemental Tables 4, 5 and 6. Supplemental Table 1 contains complete data on total OP pounds applied by OP active ingredient. The

data are ranked by individual OP-pounds applied in 2020. Supplemental Table 2 also covers all individual OPs and total OP acre-treatments.

Table 7 provides an overview of changes in total OP pounds applied and total OP acre-treatments.²⁶ Reliance by farmers on OPs has declined by well over two-thirds since the passage of the FQPA, taking into account the recent phase out of remaining uses of chlorpyrifos. The regulatory actions triggered by EPA implementation of the FQPA in the early 2000s brought about the big decline from 2000 to 2005. Overall OP use has declined more slowly, but steadily since 2005.



²⁶ Acre-treatments for a given crop-pesticide combination in a given year are calculated as acres treated multiplied by the average number of applications per treated acre. In most cropping systems, OPs are applied once per crop year, although a few exceptions occur.

Since around 2008, chlorpyrifos has accounted for about 50% of total OP acre-treatments and around 40% of total OP pounds applied. Given the cancellation of all chlorpyrifos tolerances in 2021, it remains to be seen whether farmers previously dependent on chlorpyrifos will switch to other OPs, other insecticides, or lessen insecticide use by adoption of more complex, multi-tactic bioIPM systems. Recent, in-depth analyses of changes in insecticide use in California carried out by HHRA suggest that most growers have switched to relatively new, reduced-risk insecticides, and in particular, spirotetramat.²⁷

Table 7. Overview of Changes in OP Pounds Applied and Acre-Treatments Across all Crops from 1991 to 2020 (million pounds)

	1996	2000	2005	2010	2015	2020	Change from 1996 to 2020
OP Total Pounds Applied	29.1	23.2	16.1	13.1	11.3	9.9	-66%
OP Total Acre-Treatments	30.3	22.6	21.1	17.7	14.2	10.7	-65%

For this reason, we project that in 2023, total OP use will be around 7 million pounds and likely around one-quarter of use in 1996. In addition, corn will continue to account for a substantial share of use, despite dozens of alternative management practices. *Today's modest and steadily falling use of OPs is an important reason why we believe the time has come for American farmers, the pesticide industry and regulators to move on from the OP family of insecticides.*

8. Alternatives to OP Insecticides

EPA's reduced-risk registration process and industry's positive response to it has facilitated the proliferation of numerous alternatives to OPs and demonstrably reduced reliance on OP products.

Agriculture is in the midst of a "Golden Age" of insect pest management. Alternatives abound. The steady growth of organic fruit and vegetable production demonstrates that many farmers have found ways to wean their IPM systems not just off OPs, but off all other synthetic chemical insecticides.

²⁷ Benbrook, Charles, Kegley, Susan, & Baker, Brian; "Organic Farming Lessens Reliance on Pesticides and Promotes Public Health by Lowering Dietary Risks;" *Agronomy*, 2021, 11(7); DOI: 10.3390/agronomy11071266.

Two university scientists published a 1998 paper entitled “GOLDEN AGE OF INSECTICIDE RESEARCH: Past, Present, or Future?”²⁸ The authors conclude the abstract with this observation:

“Insecticide research, having passed through several Golden Ages, is now in a renaissance of integrating chemicals and biologicals for sustainable pest control with human safety.”

It is important to recall that OPs were the most important class of insecticides in the U.S. and globally in the mid-1990s. Passage of the FQPA in 1996 generated considerable anxiety in the pesticide industry and farm community over the possible loss of many, or even all OPs. This anxiety was channeled into pressure on the EPA, Congress and the White House to assure that farmers were not left hanging as a result of rapid and broad-based restrictions on OP use. Policy-makers responded swiftly and constructively.

On September 4, 1997, just a little more than a year after passage of the FQPA and two years before the first regulatory actions reduced OP uses and risks, the EPA issued Pesticide Registration Notice (PRN) 97-3, “Guidelines for Expedited Review of Conventional Pesticides under the Reduced-Risk Initiative and for Biological Pesticides.”²⁹

This notice described a number of changes in the EPA process adhered to in reviewing and approving registration applications for new pesticide active ingredients. The changes were structured to accelerate registration of safer, reduced risk and biopesticide alternatives to the OPs. The 1996 FQPA called for the creation of such incentives to bolster the discovery and registration of OP alternatives.

The goal of EPA’s reduced-risk program is straight forward -- encourage development and registration of pesticides that will lower risk to human health and the environment compared to currently registered products, and especially reduce reliance on OPs. And according to the EPA Notice: “The major incentive which EPA offers for these pesticides is expedited registration review.”

The reduced-risk initiative was first codified in a July 1992 Federal Register notice and was superseded by a September 1997 notice. Between July 1992 and September 1997, registrants had applied for reduced-risk status for 39 new insecticides. Of these, 22 were granted reduced-risk status and 14 were registered on an accelerated basis. Of the 14, two were important OP alternatives – Dow AgroSciences’ spinosad and the insect growth regulator tebufenozide.

²⁸ Casida JE, Quistad GB. “Golden age of insecticide research: past, present, or future?” *Ann Rev Entomol.* 1998;43:1-16. doi: 10.1146/annurev.ento.43.1.1. PMID: 9444749. Accessible at <https://pubmed.ncbi.nlm.nih.gov/9444749/>.

²⁹ Accessible at <https://www.epa.gov/pesticide-registration/prn-97-3-guidelines-expedited-review-conventional-pesticides-under-reduced>.

The benefit stemming from reduced-risk classification was significant. According to EPA: “For FY95 and FY96 (prior to passage of the FQPA in August 1996) the average total time required to register a new conventional pesticide was **thirty-eight months. For reduced-risk pesticides the average total time for registration was only fourteen months.**”

30

The most important criterion considered by EPA in granting reduced-risk status is mitigating existing human-health risk by accelerating registration of alternatives for which “toxicity [is] generally lower than alternatives (10-100X)...[the alternative] displaces chemicals that pose potential human health concerns [e.g. OPs, probable carcinogens].”

On August 24, 1998, EPA issued a second Federal Register notice on this topic.³¹ This notice left unchanged the #1 priority -- methyl bromide alternatives -- but elevated “OP alternatives that pass the reduced-risk screen” to priority #2. This Notice also placed at priority #4:

“OP alternatives that are submitted to the reduced-risk committee, judged to be significant OP alternatives, denied reduced-risk status, but recommended by the Reduced Risk Committee for expedited review.”³²

For the years 1994 through 2018, Table 8 below reports the number of new uses of insecticides and new insecticide active ingredients included in a June 2018 accounting by EPA of pesticides registered on an expedited basis because of classification as an OP Alternative, a Reduced-Risk (RR) insecticide, or an RR/OP Alternative.

A total of 153 new insecticide **uses** were registered in this 24-year period, or about 6.4 per year. Of these, about one-half (77) were classified by EPA as either OP Alternatives or RR/OP Alternative uses. A total of 28 new OP Alternatives and RR/OP Alternative active ingredients were registered. **These active ingredients now account for the majority of insecticide acre-treatments in most crops in the U.S. and globally.** There are dozens of registered uses for most of these 28 new active ingredients.

Since passage of the FQPA in 1996, EPA actions and voluntary registrant decisions have removed about 10 OPs from the insecticide toolbox. EPA has granted accelerated

³⁰ EPA Pesticide Registration (PR) Notice 97-3, “Guidelines for Expedited Review of Conventional pesticides under the Reduced-Risk Initiative and for Biological Pesticides.” Accessible at <http://ceris.purdue.edu/info/prnotice/pr97-3.html>

³¹ EPA Pesticide Registration (PR) Notice 98-7, “Changes to the Registration Priority System Involving OP Alternatives and Reduced Risk Candidates.” Accessible at <https://www.epa.gov/pesticide-registration/prn-98-7-changes-registration-priority-system-involving-op-alternatives-and>.

³² This change in policy allowed OP-alternatives to be registered on an accelerated basis that lowered risks less than 10-fold compared to the most likely OP in current use.

registration status to 59 new insecticides, resulting in *a substantial net gain in the number and diversity of chemical and biopesticide “tools” in the insect-pest-management toolbox.*³³

As farmers moved away from OPs beginning in the early 2000s, the insect pest control burden shifted on conventional farms to other conventional insecticides, relatively new reduced-risk products and low-risk bioinsecticides. Organic farmers transitioned away from essentially all synthetic chemical pesticides.

Table 8. Number of Insecticidal OP Alternatives, Reduced Risk (RR), and RR/OP Alternatives Registered by EPA from 1994 to 2018

	New Uses	New Active Ingredients
EPA Classification		
OP Alternatives	27	13
Reduced Risk	76	31
RR/OP Alternative	50	15
Totals	153	59

Alternative insecticides were typically used in conjunction with varying degrees of prevention-based bio-IPM. Such systems use information, human skills and biocontrol strategies to prevent pests from becoming a problem. But when insects do become a problem, dozens of alternatives to OPs can be applied. These alternatives fall into four categories described below.

Other “Conventional” Pesticides – 15 to 25 active ingredients for any given crop use (common trade names in parentheses):

- Typically 2 to 3 carbamate insecticides including methomyl (Lannate) and carbaryl (Sevin) and other granular products for control of soil borne insects;
- 4 to 6 synthetic pyrethroids including permethrin, esfenvalerate, bifenthrin, cyfluthrin, lambda cyhalothrin and cypermethrin;
- 6-8 miticides including emamectin benzoate (Proclaim), abamectin (AgriMek), etoxazole (Acramite, targets mites in nymph and larval stages), bifenazate (M-

³³ Genetically-engineered cotton and corn varieties expressing the biopesticide Bt (*Bacillus thuringiensis*) also came on the market in the late 1990s and have provided farmers additional options for insect pest management.

- Pede, Intrepid), fenpyroximate (Akari, Forbid) and pyridaben (Endeavor);
- 3 to 4 neonicotinoids including Bayer's imidacloprid (Admire) and clothianidin, acetamiprid and Syngenta's thiamethoxam (Cruiser, Actara); and
- Chlorantranilprole (Coragen), cyzapyr (Exeril, Verimark), and other Group 28 insecticides.³⁴

Non-Conventional or “Reduced Risk” Pesticide Active Ingredients – 10 to 30 alternatives for any given crop:

- Spinosad (SpinTor, Success), products that control a wide range of insects (e.g. worms, thrips), and a next-generation, improved product spinetoram (Delegate, Radiant);
- 4-6 Insect Growth Regulators (IGRs) products targeting worms, white flies, nymphs and other insects that work by disrupting insect development, e.g. tebufenozide (Confirm), methoxyfenozide (Intrepid), buprofezin (Applaud) and clofentezine (Apollo), hexythiazox (Savey), pyriproxyfen (Knack) among others;
- Indoxacarb (Avaunt) for worm control;
- Pymetrozine (FulFill) targeting aphids;
- Spiromesifen (Oberon) for white fly nymphs and mites;
- Spirotetramat (Movento), a translaminar (i.e. moves into plants) for control of sucking/chewing insects and primary alternative when growers stopped using chlorpyrifos;
- Fipronil (Regent);
- Flonicamid (Beleaf) aphicide;
- Sulfoxaflor (Closer, Transform) for aphids, white flies; and
- Pyriproxyfen (PQZ, Rycar).

Biological Pesticides, or Biopesticides – 10 to 15 alternatives for most crops:

- Neem oil and products containing azadirachtin;
- Pyrethrins and other botanicals;
- Petroleum and dormant oils, and soaps;
- Biopesticides like *Bacillus thuringiensis* (Bt) [Zentari, Dipel] and *Beauveria bassiana*;
- Transformed kaolin clay (Surround) to coat fruit and limit insect damage;
- Multiple viruses for worm control; and
- Multiple pheromones for insect mating disruption.

Integrated Pest Management Systems and Other Biologically-Based Practices – 6 to 15 proven tactics and practices for most crops:

- Support biodiversity of soil life by reducing tillage and planting cover crops;
- Mating disruption through use of pheromones;

³⁴ Insecticides are grouped into families of chemistry based on how they control target pests. A key insecticide resistance-management strategy entails alternating modes of action in subsequent sprays to minimize the selection pressure on insect populations. Information on the prevalence of insects resistant to insecticides and insecticide Groups is accessible at <https://irac-online.org/about/resistance/management/>.

- Targeted use of Insect Growth Regulators in combination with mating disruption;
- Area-wide reduction in pest populations through crop rotation and measures to suppress populations and reduce areas accessible to insects to over-winter;
- Release of beneficial organisms and classical biological control;
- Establishment of habitat supportive of beneficial insects in and around fields; and
- Trapping methods or trap crops, often in conjunction with pheromones or other attractants.

In the 1970s and 1980s, most widely used insecticides worked via lethal modes of action, many of which also posed risks to mammals (e.g. the OPs via AChE suppression in both insects and people). A majority of newer active ingredients target a biochemical, physiological, reproductive or morphological process that is unique to insects. Most of these new insecticides work at low or very-low rates of application and rarely leave detectable residues in food. Most pose modest or very low risks to farmworkers and bystanders, and very-low or no risk stemming from dietary exposures and tolerances.

This is why most entomologists still consider the current era a Golden Age for insect pest management. Not only has the number of chemical options risen, the diversity, safety and selectivity of newer products is clearly superior to market leaders in the 1980s and 1990s. Equally important, more and more farmers are perfecting multi-tactic pest management systems that use “many little hammers” to keep pest populations low and contained, thereby reducing reliance on pesticides.

Grower-Led Efforts to Reduce Reliance on High-Risk Pesticides

Three long-running programs are described below that have focused on reducing reliance on high-risk pesticides via creative use and integration of non-chemical control strategies and newer, reduced-risk biopesticides.

Many organizations and grower groups have carried out projects with the goal of reducing or eliminating use of OP insecticides and other high-risk chemistry. The IPM Institute of North America, founded and led for many years by Dr. Thomas Green, the current chair of (NGO) HHRA’s Board, has promoted reduced and low-risk pest management systems for over 30 years in both the ag sector and urban/residential pest management.

The Institute has worked with Sysco, McDonald’s, Walmart, Frontier Coop and more than two dozen additional companies and certification programs to reduce pesticide risk and improve sustainability more broadly using a proven formula. The formula involves surveying and analyzing supply chain practices, identifying high risks to health and environment, including specific high-risk pesticide uses, working closely with suppliers and experts to identify alternatives, and promoting those alternatives. The Institute led a team of scientists to develop an on-line tool to evaluate pesticide applications for risk beginning in 2009. With USDA, EPA and industry funding, the Pesticide Risk Tool is a key component for evaluating supply chains for opportunities to reduce risk.

In the early 1990s, reliance on aldicarb, the most acutely toxic insecticide ever discovered, was causing a suite of problems in the central-sands region of Wisconsin. The problems included a precipitous drop in the value of some homes drawing drinking water from aquifers contaminated with aldicarb and other high-risk pesticides, including OPs. In response, the Wisconsin Potato and Vegetable Growers Association (WPVGA), World Wildlife Fund (WWF), and the University of Wisconsin-Madison (UW) began the “Healthy Grown” potato program.³⁵

This award-winning IPM project is still going strong and attracting new growers and an incrementally higher percent of the state’s potato and vegetable acreage. It is expanding its certification program to encompass carrots and onions grown in rotations on many potato farms. Adherence to program goals and accomplishments are verified by the Great Lakes Agricultural and Research Service.³⁶

From the beginning, reducing the use of high-risk OPs and carbamate insecticides targeting the Colorado potato beetle was a key program focus. The approval of imidacloprid and its rapid adoption by WPVGA growers dramatically cut reliance on methamidophos, oxamyl, and other high-risk OP and carbamate soil insecticides. The Collaboration’s original goal was to reduce reliance on 11 high-hazard pesticides, including several OPs through reductions in annual “toxicity units”³⁷ stemming from use of these compounds. By 1997 Wisconsin growers had reduced the toxicity units associated with pesticide use in potato production by 25% compared to a 1995 baseline and 37% by 1999. In total the volume of the 11-high risk pesticides was reduced by a half-million pounds in the first four years of the program.

Such rapid results were achieved because of the existing, strong working relationships between WPVGA growers, crop consultants, and University of Wisconsin faculty and staff who had worked together for many years via partially grower-funded research, education, and extension programs. In recent years the WPVGA-WWF-UW collaboration has been working to:

- Develop landscape-level ecological plans including pollinator protection areas,
- Effectively prevent the spread of insects resistant to insecticides, and
- Promote biodiversity and resilience through adoption of multi-tactic, biointensive IPM systems.

³⁵ <https://wisconsinpotatoes.com/healthy-grown/>

³⁶ See <https://www.greatlakesag.com/> for information.

³⁷ The Collaboration developed a multi-attribute model to calculate the toxicity units associated with a given application rate of a specific pesticide. The model encompassed applicator and consumer/dietary risks, impacts on birds, fish and other non-target organisms, and on beneficial insects and pollinators. The IPM Institute and a certifier (Protected Harvest) worked with the Collaboration for decades to incrementally refine the basis for estimating toxicity units per pound of pesticide active ingredient applied.

Another long-running program led to an end of OP use in tree-fruit production on many farms in New England. This ecolabel program was started by Red Tomato, a progressive retailer in the Boston area. Red Tomato's Eco Certified fruit program includes 3rd-party certification of ecological farming practices for apple and peach growers in the northeastern USA.

Since 2005, in a typical year, the program has certified 12-20 orchards and 1,000-2,000 acres. In 2007, all Eco Certified growers eliminated all in-season applications of OPs, while allowing one application of Lorsban (chlorpyrifos) during the dormant season on tree trunks. Apple growers replaced OPs as a central pillar of their insect management plan with a combination of bio-IPM practices including scouting, mating disruption, promotion of beneficials, and carefully timed and targeted use of low-risk insecticides. This achievement is particularly notable given the often-heavy insect-pest pressure common throughout New England.

The science and certification aspects of the Eco Certified program are managed by the IPM Institute of North America. A comprehensive set of Eco Certified production protocols has been written by the IPM Institute with support from growers, several land grant and cooperative extension pest management scientists from Cornell, U. of Massachusetts, U. of Connecticut, U. of Rhode Island, and the U. of Maine. The program details the practices and materials that constitute ecological orchard production. Some practices are required for all participants, some are recommended for extra credit. The protocol includes a list of materials that are prohibited, allowed, or allowed only with justification. A new program, Tru Earth, modeled after Eco Certified was initiated in 2014 in the upper Midwest by Westcott Agriproducts and the IPM Institute, and growers supplying Westcott.

The Lodi Wine Grape commission in California initiated a winegrape biointensive IPM program in 1991. The Lodi winegrape Crush District #11 produces more than 20% of the winegrapes in California on about 100,000 acres of vineyards. As of 2021, the LODI RULES for Sustainable Winegrowing Certification Program³⁸ has grown to encompass over 130 growers certifying more than 63,000 vineyard acres in 13 of the 17 California winegrape Crush Districts, plus 670 acres in Israel and 259 acres in Washington State. Lodi growers are certifying more than 30% of vineyard acres in their Crush District. Adherence to "LODI RULES" requirements are certified by Protected Harvest.³⁹

The sustainable/regenerative wine grape growing practices featured in the "LODI RULES" have been widely embraced and incorporated in similar wine grape programs throughout California, Washington, and New York. The program utilizes a sophisticated model to estimate the "impact points" associated with all pesticides used by growers in each of their

³⁸ <https://www.lodigrowers.com/certification/>

³⁹ <https://www.protectedharvest.org/>

vineyards every year, and places an overall, annual cap on those points for a grower to retain certification.

The impressive impact of the program is evident in the degree to which Lodi growers have weaned themselves off routine reliance on OPs and other high-risk chemistry. From 1999 to 2014 the use of Proposition 65-listed materials⁴⁰ used on Lodi vineyards (Diuron, Mancozeb, Surflan, and Omite) declined by 81%, the use of materials with the potential to leach into ground water (Diruron, Solicam, and Simazine) declined by 62%, and materials used on Lodi vineyards shown to be reproductive toxins (Agrimec, Rally and Omite) declined by 89%⁴¹. In recent years a majority of growers in the program do not use any OPs, and when they do, they are applied sparingly to limited acreage.

9. Economic Impact of OP Exposures

Part I of Petition calls for moving expeditiously to prevent harm to people from OP exposures. Pesticide manufacturers and agricultural interests have raised the prospect of serious adverse economic consequences if EPA revokes the remaining OP tolerances.

Over the last 20 years EPA has revoked or lowered hundreds of OP tolerances and cancelled all food uses of around 10 OPs. At each stage of this process, some grower groups and the pesticide industry have predicted dire economic consequences, including even a shortage of fruits and vegetables (recall the empty pickup truck advertisement in Section 2). Fortunately, growers and the industry have just as consistently found alternative ways to keep insects under control, despite lessened reliance on some OPs.

History shows clearly that there have been modest and short-lived adverse economic consequences from incremental progress in lessening reliance on OP insecticides. This will almost certainly remain the case if and when EPA revokes the remaining OP tolerances, bringing an end to the use of OPs on food crops in the United States.

Moving forward, the EPA must adhere to the core provisions of both the FQPA and FIFRA in its response to the petition. Can it find a way to lawfully adhere to the provisions of both statutes?

We believe EPA can – and must – abide by requirements and standards set forth in both the FIFRA and FDCA statutes.

The Food Quality Protection Act governs the tolerance setting process, as well as EPA actions on tolerances in the course of reregistration, a special review, or a cancellation action. It calls upon EPA to make an important scientific determination based on credible

⁴⁰ Pesticides known to pose risk of cancer or adverse birth outcomes.

⁴¹ Ohmart, C. 2017. Lodi growers reduce pesticide risk. *Wines & Vines* March 2017: 32-34.

and convincing data – that there is a “reasonable certainty of no harm” following ingestion by consumers, and particularly pregnant women, infants, and children, of pesticide residues in food that are sanctioned by existing tolerances.

Two of the FQPA’s profound changes in federal food safety law and policy warrant emphasis.

First, the FQPA places the burden on the EPA to determine that the residues in food covered by a given tolerance are “safe” (i.e. they meet the FQPA’s “reasonable certainty of no harm” standard). Prior to the passage of the FQPA and under the FIFRA statute, **EPA bore the scientific burden of proving** the likelihood of adverse human health impacts from dietary exposure to a pesticide. And in doing so the EPA had to largely depend on studies done by registrants and data they generated and supplied to EPA. **Historically, the agency rarely has been able to defend the cancellation of a pesticide because of excessive dietary risk based on studies and data submitted by registrants.**

But today, failure by the EPA to make the safety determination required by the FQPA results in the revocation or reduction in tolerances. EPA does not have to prove the likelihood of “unreasonable” dietary risks. **When clear and convincing data are not available to reach the FQPA-required “reasonable certainty of no harm” finding, the FQPA forces the EPA to take actions reducing or eliminating risk.**

In the past, EPA failure to convince a court that a pesticide’s dietary risks exceed its benefits resulted in preservation of the status quo and continued use of the pesticide. Now, EPA failure to demonstrate safety results in the end of, or changes in a pesticide’s use.

Second, the FQPA explicitly prohibits EPA from taking economic impacts, e.g. “benefits” as defined in the FIFRA statute, into account in setting, reducing, or revoking tolerances.

We hope that EPA will take the actions called for in the petition, and believe EPA must because the agency cannot make the required FQPA safety determination. In response to a decision to revoke all remaining OP tolerances as called for in this petition, registrants of OP products and some farmers and farm organizations will surely continue to argue that some crop uses of OPs should be retained in light of FIFRA’s risk-benefit balancing standard.

In Section 8 we presented data showing that the diversity and efficacy of insect-pest management options are growing and that the OPs are no longer needed. Hence, the economic impacts of EPA action as called for in the petition will be modest. But here we highlight the need for EPA, growers, and the pesticide industry to include the adverse neurodevelopmental impacts of the OPs in their economic assessments and policy judgements.

In particular, attention is warranted on the findings in published studies quantifying the economic impacts on society stemming from reduced IQ and lost productivity caused by prenatal exposures to OP insecticides.

In 2012, Dr. David Bellinger, then a professor at Harvard University, published a seminal paper on the economic costs of lost IQ as children grow up.⁴² He used a measure of life-long loss of IQ called Full-Scale IQ (FSIQ). He coupled it with the economic costs to society from the loss of one FSIQ point over a person's lifetime. He derived his dollar estimate of the reduction in lifelong earning potential per FSIQ point from a variety of econometric analyses.

Bellinger collected data on factors known to impact a child's IQ, with special focus on health conditions and environmental exposures. Pre-term birth was the #1 factor accounting for lost FSIQ points in a given year -- 34 million. Lead exposure was number two at 23 million and OP insecticides were third, accounting for the loss of 17 million FSIQ points.

The fact that the estimated impact of OPs on FSIQ loss was roughly three-quarters of the impact stemming from lead exposure was a shocking finding. Bellinger's paper challenged the public health community and pesticide regulators to explore more deeply whether the nation was under-investing in efforts to reduce prenatal OP exposures, given the billions of dollars over many years invested in reducing lead exposures.

Another academic analysis estimated the economic cost of the EPA's failure to ban chlorpyrifos in the 2010s.⁴³ After reviewing the multiple lines of evidence linking prenatal and early-life exposures to chlorpyrifos to neural-developmental deficits, Professor and pediatrician Leonardo Trasande projected the impacts of the EPA's 2017 decision to reverse the ban on chlorpyrifos called for by the EPA in 2015-2016:

“...Administrator Pruitt's decision [to reverse the ban] fails to consider the reality that the cohort of US children born in 2010 lost 1.8 million IQ points and 7,500 children had their IQs shifted into the intellectual disability range as a result of prenatal organophosphate exposures.”

Trasande cites studies projecting that each IQ point lost leads to a 2% reduction in lifetime economic productivity, or about \$20,000 per IQ point. Added education and health care costs must also be taken into account for a full accounting of the economic impacts of

⁴² Bellinger DC. “A strategy for comparing the contributions of environmental chemicals and other risk factors to neurodevelopment of children,” *Environ Health Perspect.* 2012;120(4): 501-507. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3339460/>.

⁴³ Trasande L. “When enough data are not enough to enact policy: The failure to ban chlorpyrifos,” *PLoS Biol* 15(12): e2003671. <https://doi.org/10.1371/journal.pbio.2003671>.

early-life chlorpyrifos exposures. Trasande projects that combined chlorpyrifos exposures over the lifetimes of the children born each year would cost society \$44.7 billion annually, **orders of magnitude above any realistic calculation of the net benefits arising from farm use of chlorpyrifos, and indeed all OPs.**

A team led by Trasande published another, similar analysis in 2020.⁴⁴ The team focused on polybrominated diphenyl ethers (PBDEs), OPs, methylmercury and lead. Biomonitoring data from the CDC's National Health and Nutrition Evaluation Study (NHANES) was used, in conjunction with the results of epidemiology studies reporting statistically significant associations between prenatal and early life exposures and adverse neurodevelopmental outcomes.

These updated estimates of lost IQ points adhered to a methodology outlined by the Institute of Medicine and applied in Bellinger's seminal 2012 study. For the OPs, Trasande's 2020 team estimated that 4.25 IQ points would be lost per 10-fold increase in prenatal OP exposure. Each lost IQ point was valued at \$22,268. Each case of intellectual disability was projected to impose lifetime costs of \$1,272,470.

Based on these estimates, the four chemicals in this 2020 study imposed on society an estimated \$6 trillion in lifetime costs over the 15-year study period (i.e. life-long impacts across all children born in the 15-year period.) PBDEs accounted for the largest impact at \$3.6 trillion, lead was second at \$1.7 trillion, and **OPs were third, accounting for an estimated \$594 billion in societal costs over 15 years, or nearly \$40 billion on average per year.**

We acknowledge that the data available to Bellinger, Trasande and others attempting to monetize the impact of chemicals on IQ and an individual's lifelong productivity are incomplete and that the methods used to do so are imperfect. However, both the data and existing methods are adequate to show with a high level of certainty that the economic consequences of continued OP use will dwarf the modest net benefits in the ag sector, if any, from continued OP use.

Hence, economic arguments advanced to discourage EPA action on this petition are unfounded when the full slate of economic impacts stemming from continued OP applications on food crops are taken into account, **as they must be under FIFRA.**

10. Reducing Adverse Impacts of OPs on Farmworkers, Applicators and Rural Communities

⁴⁴ Gaylord et al. "Trends in Neurodevelopmental Disability Burden Due to Early Life Chemical Exposure in the USA from 2001 to 2016: A Population-Based Disease Burden and Cost Analysis," *Mol Cell Endocrinol.* 2020 doi: 10.1016/j.mce.2019.110666.

Part IV of the petition calls for cancellation of OP registrations that pose unreasonable adverse effects on farm workers, applicators, and rural communities. Even EPA's currently flawed OP worker-risk assessments point to high and often unmitigated exposures and risks.

The absence of adequate real-world OP worker exposure data, coupled with serious gaps in occupational risk-assessment methods, undermine EPA's worker safety determinations. Likewise, EPA's existing OP-risk assessments fail to adequately account for non-occupational exposures and risks within rural communities where OP use is common.

These failures over the last 25 years is a regrettable example of systemic environmental injustice. These failures are especially galling in light of the fact that reducing OP use and risks has been the stated priority in EPA's Office of Pesticide Programs since passage of the FQPA in 1996.

Revoking and phasing out OP tolerances as called for in this petition will deliver substantial, long-overdue benefits to farmworkers and applicators, as well as people living near fields treated with OPs. EPA regulates occupational and non-occupational bystander risk by quantifying dermal and inhalation exposures. The term "bystander" in the context of EPA human-health risk assessments refers to people living near, or spending time near treated fields or areas, but not working in the fields or applying pesticides.

The acceptable Margin of Exposure (MOE) for occupational and bystander exposures is derived by dividing the applicable OP Point of Departure (POD) based on toxicology studies by estimated exposures. The POD is the lowest level at which the EPA expects adverse impacts to occur based on animal, human, and epidemiological studies.

When exposures are 100-fold or more lower than the POD (10-fold in the case of a human-study based POD), the EPA deems the exposures (and MOE) acceptable.

Unfortunately almost all OP dermal penetration studies done by registrants are based on tests using pure active ingredient, **and not formulated OP products**.

EPA regulations grant registrants the right to choose whether to conduct dermal penetration studies on active ingredients or formulated products. It is no secret in the industry why virtually all such tests are done using active ingredients.⁴⁵ As argued earlier in our comments, this is a failure of law and policy, and one that needs to be addressed worldwide, **and as soon as possible** in order for scientists to do a better job in recognizing and quantifying the public health impacts of pesticide use and exposures. Understanding where the risks are is obviously a first step in curtailing them.

⁴⁵ The "inert ingredients" in formulated pesticides often increase the rate of dermal penetration and raise the risk of a host of adverse health outcomes. This is why pesticide manufacturers virtually never conduct longer-term health studies on formulated products.

In the 2011, 2014, 2016 and 2020 chlorpyrifos HHRAs, the EPA estimated excessive occupational and/or bystander exposures in many scenarios involving applications of chlorpyrifos on dozens of crops. The Agency was able to reach acceptable MOEs of 100 or higher only with reduced application rates in conjunction with extensive PPE requirements. For many OPs, EPA worker-exposure scenarios require engineering controls, plus PPE, plus use reductions to reach MOEs of 100 (e.g. low-exposure methods to transfer concentrate into spray tanks; a steel-glass cab for the applicator to sit in, while wearing a respirator and Tyvek suit).

In recent OP worker-risk assessments, EPA has tried to come up with a quantitative estimate of the combined effects of multiple OP exposure-reduction measures. This daunting task led EPA to produce and refine over several years a surrogate table of expected reductions in worker and applicator exposures as a function of combinations of exposure-mitigation interventions.⁴⁶

This surrogate table of estimated reductions in exposure allowed EPA to estimate the impact of dozens of combinations of PPE and engineering controls across 500 or more OP applicator and bystander exposure scenarios. While helpful in gauging the impact of label changes on OP exposure levels, the science and data supporting these estimates is old and flawed.

In the case of OPs, the failure of EPA to insist on testing⁴⁷ of full-formulation dermal and inhalation exposures has perpetuated often serious underestimation of actual OP risk. This is because of the presence of volatile “inert ingredients” in most OP products. Volatile coformulants are added to end-use OP insecticides because the insecticide must move throughout the canopy of a sprayed crop to enhance the odds target insects will come into contact with the active ingredient that kills susceptible insects.

As noted before, if the EPA chooses to not revoke all remaining OP tolerances, the EPA and pesticide registrants will need to invest substantial resources over many years to produce accurate, real-world OP worker and non-occupational exposure estimates. Without such data, efforts to protect farmworkers, applicators, and rural residents are bound to miss high-exposure scenarios that should no longer be tolerated in light of the risk-benefit standard governing pesticide regulatory decision-making.

⁴⁶ Access the surrogate tables at <https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/exposure-surrogate-reference-table-pesticide-risk>.

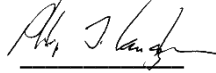
⁴⁷ Such testing should include properly designed studies carried out by scientists independent of the pesticide industry.

September 24, 2022

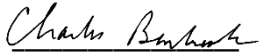
Please consider all supplemental tables submitted in a separate Excel file as part of these comments, as well as the peer-reviewed papers cited herein which we have submitted to the docket. Thanks for this opportunity to comment.



Kathleen A. Merrigan



Phil J. Landrigan



Charles Benbrook