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Exploring the Harmful Health Effects of Chlorpyrifos on Children: An Argument for Policy Reform

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Table of Contents

Abstract

Chlorpyrifos is an organophosphate neurotoxic insecticide, which poses a significant risk to children's health. Exposure to chlorpyrifos during childhood, infancy and pregnancy has been linked to autism, ADHD, developmental delays, and lower IQ. My internship at the Natural Resources Defense Council in San Francisco consisted of completing analyses and creating science, policy and communications materials to support health protective policies for chlorpyrifos in the market and at the federal and state levels. Information pertaining to the widespread use and harmful effects of chlorpyrifos was gathered and presented in fact sheets, spreadsheets, graphs and bulleted talking points. Data analyses and literature reviews were conducted on specific states to identify chlorpyrifos policy as well as use and harmful effects in agricultural communities. Market research was conducted on chlorpyrifos use and residues on apples, from which a fact sheet was created advocating for organically grown produce. The EPA's list of alternatives was analyzed for efficacy, price and toxicity. A general chlorpyrifos fact sheet was created translating the scientific findings and analyses into lay terms, for state policy makers and the market. On March 29th 2017, the EPA announced its decision to deny the petition, filed in 2007 by the NRDC and PANNA, to revoke all uses of chlorpyrifos on food crops. Further work will include suing the EPA to appeal the government's decision and implement a court-imposed ban on chlorpyrifos. If this proves unsuccessful advocates and coalitions must come together to generate public awareness as to the harmful effects of this toxic chemical, one way this can be accomplished is by conducting further epidemiological studies. A top priority for pesticide reform coalitions must be to revoke all food crop uses of chlorpyrifos in individual states, this can be achieved by lobbying state policy makers and regulatory agencies for health protective policy reform.

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Introduction

Chlorpyrifos is an organophosphate insecticide, applied to food crops and animal feed, used primarily to combat foliage and soil-borne insects (U.S. Environmental Protection Agency, 2016a). Chlorpyrifos is a neurotoxic chemical, which kills insects by affecting the function of their nervous system (Tomlin, 2004). Acute human exposure to chlorpyrifos can over-stimulate the nervous system resulting in symptoms such as nausea, dizziness, confusion, respiratory difficulties, and at very high levels death. It is applied by either ground or aerial equipment to nurseries, green houses, animal feed, and a variety of food crops (U.S. Environmental Protection Agency, 2016a). Chlorpyrifos is owned and manufactured by Dow Chemical Company and is sold commercially as Dursban and Lorsban. Today, over 5 million pounds of the insecticide is applied annually on agricultural crops across the United States (U.S. Geological Survey, 2014).

Organophosphates were developed in World War II by the Nazi's to function as nerve gas agents. Developed in the early 1900's and made available around WII, chlorpyrifos is chemically similar to nerve gases used in the war, such as Saran gas (Lein & Fryer, 2005). It has been used as a pesticide since 1965, to combat insects in both agricultural and non-agricultural settings, such as homes and green houses (U.S. Environmental Protection Agency, 2016a). In 1999 the United States Environmental Protection Agency (U.S. EPA) ordered DowElanco to pay over $800,000 for violating a federal law, which required the company to report human health risks associated with exposure to chlorpyrifos. Due to the detrimental health impact this pesticide poses to infant and child health, the U.S. EPA revoked most residential uses of chlorpyrifos in

2001 (U.S. Environmental Protection Agency, 2016a). The U.S. EPA's 2016 Chlorpyrifos Revised Human Health Risk Assessment for Registration Review indicates that expected exposure to chlorpyrifos from food crop residues exceeds the safety standard established under the Federal Food, Drug and Cosmetic Act (U.S. Environmental Protection Agency, 2016c).

Problem Statement

Infant and child exposure to pesticides is concerning because the developing brain is susceptible to neurotoxic effects, some studies indicate that these effects can be permanent (Bradman et al., 2005; Eskenazi et al., 2007). Exposure to chlorpyrifos during pregnancy and infancy has been linked to developmental delays, lower IQ, autism and ADHD (V. Rauh et al., 2011; V. A. Rauh et al., 2006; R. M. Whyatt et al., 2005). Studies have found that chlorpyrifos is able to penetrate the placental barrier during pregnancy (Eskenazi et al., 2007). Expectant mothers exposed to the insecticide during pregnancy have higher rates of children born with impaired cognitive and motor development. The neurotoxicant effects of prenatal exposure to chlorpyrifos were measured among a cohort of inner-city women and children. The study examined cognitive and motor development through the first 3 years of life among children exposed to varying levels of chlorpyrifos in utero. The researchers found that the children exposed to higher amounts of chlorpyrifos had delayed functions in the Psychomotor Development Index and Mental Development Index (V. A. Rauh et al., 2006). Another study found an association between prenatal exposure to organophosphate pesticides and a seven-point reduction in IQ levels and reduced memory function in children (Bouchard et al., 2011). According to The CHARGE study, conducted by the UC Davis MIND Institute, pregnant women who reside near agricultural regions treated with chlorpyrifos are at an increased risk of having a child born with autism. The 2014 study found that the risk of autism triples when the pregnant women lives within a mile of agricultural regions treated with chlorpyrifos during the second trimester of pregnancy (Hertz-Picciotto et al., 2006). The 2001 ban on residential uses of chlorpyrifos resulted in a decrease of exposure to pregnant mothers and their fetuses, for example from 1999 to 2002 chlorpyrifos umbilical blood cord levels fell from 6.9pg/g to 1.2pg/g respectively, which resulted in higher weight and greater length at birth (R. M. Whyatt et al., 2005).

Chlorpyrifos enters the body through inhalation, direct contact, and consumption of the insecticide. Children come in contact with higher levels of chlorpyrifos than adults, by playing on the floor and in the dirt, putting things in their mouths, and eating more fruits and vegetables (Bradman et al., 2005). Relative to their size, when compared to adults, on a daily basis children ingest, inhale and consume more chlorpyrifos (V. A. Rauh et al., 2015; Robin M. Whyatt et al., 2002). A study conducted in 2008 found that 91% of children tested had detectable levels of organophosphate breakdown products in their bodies (Fenske, Lu, Barr, & Needham, 2002). Chlorpyrifos is present in many places and things assumed to be safe for children from the mother's womb, to the classroom, and the food they eat. The very fruits and vegetables that are said to be beneficial for children can be causing detrimental effects to their neurological development and overall health. Exposure to chlorpyrifos, in non- agricultural communities, occurs through consumption of pesticide residue on food crops and contaminated drinking water.

Exposure Through Food Residues and Contaminated Water

A study conducted in Seattle in 2003 found preschool aged children, who did not reside near agricultural regions treated with chlorpyrifos, were exposed to unsafe amounts of the insecticide by consuming produce that contained chlorpyrifos residue (Curl, Fenske, & Elgethun, 2003). A study in Maryland assessed the effects of chlorpyrifos exposure on a group of volunteer participants. The researchers measured the amount of food residues on the produce that the participants ate to determine if this altered the levels of chlorpyrifos in the body. They found that the participants who consumed foods with higher levels of pesticide residue on them had higher levels of chlorpyrifos in their bodies (MacIntosh, Kabiru, Echols, & Ryan, 2001). This indicates that individuals, particularly children, across the country, not just in agricultural regions, are exposed to chlorpyrifos through pesticide residues on food crops. Removal of all pesticide residues from produce is nearly impossible; even with vigorous washing some pesticide residues still remain. Eliminating all uses of chlorpyrifos will reduce expectant mothers and children's exposure to the pesticide. The U.S. EPA has concluded, through their own studies, that exposure to chlorpyrifos through food residues leads to unsafe levels of the pesticide within women and children's bodies (U.S. Environmental Protection Agency, 2014).

A conventional diet leads to unsafe levels of chlorpyrifos in the body; this is due to the consumption of pesticides through food residues. Scientists have measured the difference between a conventional diet and an organic diet in respect to pesticide exposure, and particularly exposure to organophosphates. One study followed two cohorts of preschool aged children, over the course of three days. One cohort consumed a conventional diet while the other cohort consumed an organic diet. The researchers instructed the parents of the children to maintain a food diary to document what the children ate. The study found that children who consumed an organic diet had significantly lower levels of organophosphates in their bodies than those with conventional diets (Curl et al., 2003). There were almost no traceable levels of chlorpyrifos in the bodies of the children who consumed an organic diet (Fenske et al., 2002). A study conducted on 3-11 year olds over the course of one year researched the impact of a conventional diet on the level of chlorpyrifos within children's bodies. The children were fed a conventional diet the majority of the year, with the exception of two five-day periods were they were fed an organic diet only. At the end of the 5-day organic diet the researches found close to, non-detectable levels of chlorpyrifos in the children's urinary metabolite concentrations. When the children were fed conventional diets they had detectable levels of organophosphates in their bodies that fell above the U.S. EPA levels of safety (Lu, Barr, Pearson, & Waller, 2008). These studies indicate that exposure to chlorpyrifos occurs across all populations, not just within those that live near agricultural regions treated with chlorpyrifos. In order to eliminate the dangers of chlorpyrifos exposure, individuals had to switch over to organic diets. Organic foods tend to be considerably more costly than conventional produce. Many families lack access to organic foods due to the high costs and geographic inaccessibility of organic foods, in order to reduce exposure to all populations from this toxic pesticide it is imperative that the U.S. EPA revoke all uses of chlorpyrifos on food crops.

The U.S. EPA found chlorpyrifos contamination of drinking water in all 50 states. Unsafe levels of contamination have been found in ground and surface waters across the nation, with extremely high levels of chlorpyrifos in agricultural regions (U.S. Environmental Protection Agency, 2014). Pesticides enter the water supply primarily through spray drift, field runoff and water supply leaching into ground and surface waters. Theses waters then migrate across the country thorough streams and rivers (Rao, Mansell, Baldwin, & Laurent, 2012). The U.S. EPA's risk assessment of drinking water found current levels of chlorpyrifos that exceed the safe levels of consumption for all individuals, not just children. Due to the detrimental neurological effects that chlorpyrifos exposure can have on children, the assessment concluded that there are no safe levels of chlorpyrifos in drinking water (U.S. Environmental Protection Agency, 1996, 2016b).

The evidence is clear exposure to chlorpyrifos has damaging effects on children's brain development. Studies indicate that this is not a problem specific to agricultural regions; in fact exposure to chlorpyrifos is widespread and affects all populations. The continued use of chlorpyrifos has resulted in the contamination of soil and water, leading to dangerous levels of chlorpyrifos in food and water supplies. This does not take into account the extremely high levels of pesticides the women and children living in agricultural regions are exposed to everyday. This also does not account for the large number of acute chlorpyrifos poisoning incidents that occur yearly during pesticide application. Farmworkers and those living near agricultural fields are exposed to extremely unsafe levels of chlorpyrifos through application and pesticide drift.

This paper focuses on the effects of this pesticide on the general population, and illustrates how chlorpyrifos poses significant risk to all individuals, including those living in non-agricultural regions. This is a problem for the entire country, it is a problem that is leading to a change in the health of children and altering the trajectory of human health. In 2001 the U.S. EPA acknowledged the dangers of chlorpyrifos in the home, and banned most residential uses of it. Yet, the pesticide continues to be used on outside settings and heavily within agricultural regions. The detrimental neuro-developmental effects of chlorpyrifos are undeniable; in order to protect the future of our children the U.S. EPA must ban all uses of chlorpyrifos on food crops.

Background

Over the years many famers have become dependent on the use of chlorpyrifos to mitigate for a wide array of insects and unwanted foliage. Some of the insecticide's most appealing attributes are its availability, effectiveness, and low-cost. Environmental activist and organizations have taken it upon themselves to influence the use of chlorpyrifos in agricultural settings. This has proven to be extremely difficult and is met with much resistance from the agricultural industry. The residential ban of chlorpyrifos use in 2001 required mobilizing pesticide reform organizations across the country. The Californian's for Pesticide Reform (CPR) is a coalition of advocacy, litigation, and science based organizations that come together on a community level to fight for the rights of humans and the environment in respect to pesticide exposure. Due to the difficulty of influencing famers directly, and the inability of most American's to purchase organic produce advocates have decided to target policy reform and affect change on the federal policy level. The CPR and its members played an integral role in revoking most residential uses of chlorpyrifos in 2001.

In 2007 The Pesticide Action Network of North America (PANNA) and The Natural Resources Defense Council (NRDC) filed a petition to revoke all uses of chlorpyrifos on food crops, based on the large body of evidence, which associates the pesticide with brain damage from prenatal exposure and toxic drift. In 2011 the U.S. EPA conducted its own preliminary risk assessment of chlorpyrifos and acknowledged its legal obligation to protect children from pesticide drift (U.S. Environmental Protection Agency, 2014). As a response, in 2012 the U.S. EPA imposed buffer zones around schools, day cares, homes, playfields, and other places occupied by people. Yet, the U.S. EPA did not account for exposure to pesticides through direct pesticide drift and inhalation exposures from groundboom and airblast spraying. In late 2014 the

U.S. EPA released its revised human risk assessment, which concluded that chlorpyrifos use poses significant risk to farmworkers and children. In the risk assessment the U.S. EPA scientists concluded that there are no safe levels of chlorpyrifos in water, and that exposure to chlorpyrifos can lead to brain damage in children. In October 2015, the U.S. EPA proposed to revoke all food tolerances for chlorpyrifos due to the contamination of drinking water, but indicated that some forms of chlorpyrifos use may be permitted to continue. In August 2016 the 9th Circuit Court of Appeals gave the U.S. EPA a deadline of March 31, 2017 to take final actions on the 2007 petition to ban chlorpyrifos and its proposed revocation of food tolerances (U.S. Environmental Protection Agency, 2016a).

In November 2016 the U.S. EPA reaffirmed plans to ban the use of chlorpyrifos on food crops; due to the new administration hopes of this petition passing are shrinking (Erickson, 2016). The CPR, PANNA and NRDC are now expecting the U.S. EPA to continue the use of chlorpyrifos on all agricultural crops, despite the mounting evidence indicating the health consequences of continued chlorpyrifos use. The next steps for environmental organizations concerned with the continued use of chlorpyrifos are to affect change on the state level. With the majority of organizations anticipating that chlorpyrifos reform will not occur under a Trump administration, change must be affected on the local level. This will include targeting governors and senators in states pushing for reform, consumer education, and appealing directly to the market through independent retailers.

Scope of the Project

I have a strong desire to promote farmworker health and pesticide reform, the majority of my coursework at the University of San Francisco was focused on pesticide reform and drift mitigation. As such, I wanted to obtain my fieldwork placement at an organization that works on pesticide reform, particularly in policy and advocacy. After reaching out to multiple contacts I was able to secure a fieldwork placement at The Natural Resources Defense Council within the Health and Environment program in the San Francisco office. I worked with Miriam Rotkin-Ellman, a senior staff scientist, and Veena Singla, a staff scientist. Both Miriam and Veena dedicate most of their work to dangerous toxics within our environment, by seeking policy reform, creating general awareness, and working with outside agencies.

Agency Description

The mission of the NRDC is ‘to safeguard the earth, its people, its plants and animals, and the natural systems on which all life depends.’ The NRDC achieves this by overseeing more then a dozen programs globally, focused on human and environmental health. There are eight areas that the NRDC focuses their work on:

- *Climate & Clean Air*, which the agency works on by promoting clean/ renewable energies.
- *Urban Solutions*, which the agency promotes by working with communities to create sustainable cities and protect communities.
- *Energy and Transportation*, the organization promotes clean vehicles, fuels and energy efficient modes of transportation.

- *Food & Agriculture,* the food program focuses on safe food, food waste, and livestock production.
- *Health & Environment*, the agency works to reduce exposure to toxic chemicals and ensure access to safe drinking water.
- *Oceans*, the NRDC prioritizes and promotes ocean protection and sustainable fishing.
- *Water,* the agency works to eliminate water pollution and create healthy rivers and ecosystems.
- *Land & Wildlife,* the NRDC advocates for wildlife conservation and wilderness protection.

The NRDC works on multiple projects at a time, in an effort to fight for human health and environmental justice. Through its work the agency strives to serve the environment and promote the health and wellness of all human beings across the world (Natural Resources Defense Council, 2017).

The NRDC is a global organization, with offices in San Francisco, Chicago, Los Angeles, New York, Washington D.C., Canada, Latin America, China and India. The organization employs roughly 500 lawyers, scientist, and advocates. The NRDC works on a broad array of environmental issues with human health as the top concern (Natural Resources Defense Council, 2017). The organization takes an ecological approach when addressing the multiple projects they work on. As an intern I was able to observe how the health program utilizes the ecological model to illicit federal and individual change within the United States. The food program works on the individual level of the ecological model by altering individual's knowledge, attitude and behavior towards food waste. They do this by educating the average consumer through online advertisements, and generating press and general awareness surrounding the issue of food waste.

The NRDC works on the interpersonal level through multiple programs, one such project within the health program is the promotion of organic foods. They do this by addressing the cultural factors surrounding the shift towards healthier eating options. This is achieved by addressing the role of food within the home, and illustrating how conventional foods can pose significant harm to our children. The NRDC works on the institutional level by creating access to healthier drinking water and food options for the general population, one way this is achieved is by targeting schools and worksites. The health program works on the community level by partnering with outside agencies to create access to healthier food options, work environments, and water. The majority of the NRDC's work occurs on the social and policy level of the ecological model. The organization has become a force to reckon with, and often has multiple lawsuits pending at a time. For example, my preceptors are working on addressing the health risks posed to nail salon workers due to their daily exposure to toxic chemicals at work. Miriam and Veena work on the social level to change the norms surrounding the use of toxic chemicals in salons and promote worker protection. They are also working on the policy level by lobbying to change current California regulations pertaining to salon worker health, specifically reducing and eliminating exposure to extremely toxic substances, such as the toxic trio toluene, formaldehyde, and dibutyl phthalate.

Project Description

The health program addresses multiple issues surrounding toxic chemicals and policy reform. My preceptor, Miriam, has worked on one chemical in particular for over ten years: chlorpyrifos. After countless delays PANNA and NRDC finally received a date by which the U.S. EPA would make a decision regarding the revocation of all food uses of chlorpyrifos. Due to the changing political climate and despite the evidence regarding the toxicity of chlorpyrifos, the NRDC anticipated that the U.S. EPA would either ask for another delay on March 31st or reject the ban completely. My preceptors wanted prepare, in the event that the U.S. EPA deny the petition, to sway policy makers, the general public, and retailers that a ban on chlorpyrifos is necessary. The goal of my project was to provide materials that illustrate the need for an EPA imposed ban of all food crop uses of chlorpyrifos, for the entire country. My project was titled: Support Health Protective Policies for the Pesticide Chlorpyrifos. We aimed to provide educational materials to policy makers and retailers and to have valuable information for the NRDC lawyers regarding the use of chlorpyrifos on the individual state levels. The NRDC planned to target individual 'sympathetic' (identified by their concern for environmental health) senators from key states, and present them with compelling evidence as to why it is in their constituents best interest, and thus theirs, to discontinue the use of chlorpyrifos in their state. The NRDC hopes to pass a ban on chlorpyrifos in multiple key states, which would set the path for the entire country to follow suit. The NRDC targeted major retailers that often utilize commodities heavily treated with chlorpyrifos. The idea behind this strategy was to push the market to change its spending habits with the expectation that as the demand for chlorpyrifos free produce goes up the agricultural industry will have to yield to the consumers preferences and supply chlorpyrifos free crops. The U.S. EPA's list of suggested alternatives include many other harmful organophosphates and fungicides, as such most of our work on the market level focused on promoting organic. We did this by illustrating how consumer demand for organic foods, in the past 10 years, has continued to grow, indicating the cost benefits of selling and marketing organic produce. The long-term objectives of my project was to help the NRDC and the pesticide reform coalitions they are working with to alter chlorpyrifos policy on the state level and influence the markets demand for produce grown organically. The objective of my project was to equip the NRDC with the information and materials necessary to sway public opinion, on the policy level and community level, towards the discontinued use of chlorpyrifos.

For this project in particular my preceptors worked closely with the NRDC health program in Washington D.C. and with the agencies environmental lawyers, also based in Washington D.C.. The NRDC partnered with multiple outside agencies to help combat chlorpyrifos on the national, state and local levels. The NRDC and PANNA joined forces in 2007 to file the petition to revoke all uses of chlorpyrifos on food crops, jointly against the U.S. EPA. The NRDC is also part of multiple state coalitions focused on reducing and eliminating the use of extremely harmful pesticides, such as chlorpyrifos. These coalitions include key players in pesticide reform such as PANNA, Earth Justice, The United Farmworkers Union, The California Institute for Rural Studies and the CPR. The coalitions aim to combine the individual expertise each organization possesses to help build a strong foundation for this movement. The NRDC is one of the largest organizations within these coalitions and is often asked lend its reputation to generate attention to a given issue.

This project utilized the ecological approach to instill regulatory change pertaining to the use of chlorpyrifos. My project in particular worked on the interpersonal, institutional, community and policy levels of the ecological model. We worked on the interpersonal level, by creating materials and talking points geared towards the general public, which indicated the many benefits of transitioning to organic produce. The project worked on the institutional level by targeting major retailers and restaurants and asking them to change their stance on the use of pesticides by altering the commodities they purchase. We did this by creating commodity specific fact sheets, with the main commodities that our target retailers use, that illustrate the economic and environmental benefits of eliminating products contaminated by chlorpyrifos in their businesses. The project worked on the community level by collaborating with multiple community organizations that also address pesticide policy reform. The project included researching and compiling data that the NRDC will share with these coalitions as they see fit. I created two state specific spreadsheets, for a total of 18 different states, which included chlorpyrifos information for each state regarding use, top commodities, and incident information. These spreadsheets may be shared with the NRDC's community partners to assist them with their individual campaigns as well. Lastly, and most importantly the project worked on the policy level. I created a general chlorpyrifos fact sheet for senators and representatives in Washington D.C., which illustrated the detrimental effects chlorpyrifos has on children, demonstrating the need to ban all of its uses. The project also included creating independent talking points for specific senators, which illustrate how chlorpyrifos is affecting their communities directly.

Public Health Impact: Findings and Significance

The fieldwork position at the NRDC resulted in chlorpyrifos related materials on specific commodities and states; this information was compiled into spreadsheets and fact sheets. Data analysis and further research was conducted on the health effects of chlorpyrifos in various populations, as well as its means of exposure to the most vulnerable populations, such as children and pregnant women. Research was conducted on the health effects and usage of chlorpyrifos for 18 different states, a compilation of studies, data, and federal statistics were gathered into two spreadsheets for the top priority and second priority states, the states were prioritized by the NRDC lawyers. This information was used to create state specific talking points for NRDC lobbyist to utilize in Washington D.C.. For each individual state, research was compiled on the agricultural uses of chlorpyrifos, specifically taking into account the amount per pound used and the top agricultural commodities treated with the insecticide.

Deliverable Results

The internship consisted largely of translating the data and scientific research found into lay terms, for the general public, policy makers, and purveyors. The culmination of this work was a general chlorpyrifos fact sheet, which will be used by the NRDC when pushing for chlorpyrifos reform, specifically when speaking with policymakers, the agricultural industry and the market (see Appendix A). The fact sheet provides general information on chlorpyrifos, including its uses, contamination, and health risk associated with exposure to it. Most of the information was pulled from federal studies and the U.S. EPA’s own assessments. By using the EPA’s assessments and science the NRDC hopes to combat the current administrations attacks on policy reforms, which they claim are based on unsound science. The primary argument posed by the agricultural industry is that there are no effective and economically feasible alternatives to chlorpyrifos, as it is both one of the cheapest and most effective insecticides on the market. Industry claims that a revocation of chlorpyrifos would lead to food shortages, economic hardships on farmers and possible starvation. The U.S. EPA constructed a list of insecticide alternatives to chlorpyrifos, in its Analysis of the Small Business Impacts of Revoking Chlorpyrifos Food Tolerances (U.S. Environmental Protection Agency, 2015). The U.S. EPA found that for 97% of farms in the U.S. there would be minimal to no economic impacts if chlorpyrifos were revoked; this is a huge finding as it dispels the agricultural industries argument (U.S. Environmental Protection Agency, 2014). A list of the U.S. EPA's recommended alternatives was compiled and assessed for toxicity (see Appendix B). The majority of the recommended alternatives are just as, if not more, toxic to humans and the environment, this is cause for concern, the NRDC wishes to reduce the exposure to harmful chemicals not replace them with equally toxic substances. Another tactic used to combat industry was to illustrate the many studies, which have been conducted on chlorpyrifos. This information was presented in graphs that illustrate the vast amount of research that has been published, per year, on chlorpyrifos (See Figure 1 or Appendix C for additional information).

California Results

In California alone over 1million pounds of chlorpyrifos was used on agricultural fields in 2015 (U.S. Geological Survey, 2014). The majority of chlorpyrifos used in California was in the Central Valley, specifically on almonds and strawberries (U.S. Department of Agriculture, 2017a).This is cause for concern as there are over 2 ½ million children under the age of 5 years old and over 9 million women of childbearing age in California (The United States Census Bureau, n.d.). California has a considerable amount of pesticide biomonitoring data, through independent studies, such as the CHAMACOS study conducted in Salinas, and through studies funded by the California Department of Pesticide Regulations. In 2011 pregnant women in the Salinas Valley had on average a concentration 132nmol/L of Dialkyl Phosphate (DAP) metabolites in their urine. DAP metabolites measure exposure to organophosphorous pesticides through urine (Bouchard et al., 2011). While children in the Salinas Valley had on average a concentration of 131nmol/L of DAP metabolites in their bodies (Bouchard et al., 2011). Salinas is considered the lettuce bowl of California, as the majority of the United States leafy greens are grown in this region. These studies illustrate how the communities living in Salinas are exposed to large amounts of dangerous pesticides. The National Water Quality Monitoring Network found concentrations of chlorpyrifos in California's water systems in 2016. The average concentration of chlorpyrifos across the state was .12ng/L and the maximum concentration found was 9.72ng/L (USGS, 2017). This is alarming considering that in 2016 the U.S. EPA released it revised risk assessment of chlorpyrifos, which stated that there are no safe levels of chlorpyrifos in water, due to the amount of chlorpyrifos residues on food crops. Research conducted in California also found unsafe levels of chlorpyrifos in the air, especially in agricultural regions (See Appendix D). California is a key state in passing chlorpyrifos reform, as such much of the fieldwork consisted of gathering information specific to the state, which will help the NRDC lobby for a ban on all food agricultural uses of chlorpyrifos in the state.

Colorado Results

Chlorpyrifos monitoring data was difficult to find for some key states, for instance in many states the only pesticide related data available was that, which was collected through federal programs, such as the United States Geological Survey (USGS), the United States Department of Agriculture (USDA), and the Centers for Disease Control and Prevention (CDC). The majority of the second priority states had limited data and almost no independent or state chlorpyrifos monitoring studies (See Appendix E). Colorado, a key second priority state, had limited information available; it was imperative that the data collected be presented in a way that would motivate senators to seek a statewide ban. In 2016 a study conducted in Colorado was published, which found an average concentration of chlorpyrifos in the tissue of native bees of 30 ng/g (Hladik, Vandever, & Smalling, 2016). This could be useful information for the NRDC lobbyist when they speak to representatives from the state.

The Centers for Disease Control and Prevention

Data for pesticide related exposure and illnesses was gathered from the CDC Pesticide Tracking Network. This is a federal resource that contains data for all 50 states, although it should be noted that many pesticide related incidents go unreported. This information proved to be extremely useful, because although California had the highest reported number of pesticides exposures to carbamates/ organophosphates at 427 reported cases, Missouri had the highest rate of exposure at a 1.65 rate of reported exposures per 100,000 people (Centers for Disease Control and Prevention, 2017). This could be an indication of improper training and monitoring in Missouri, which would be a useful piece of information to present to state representatives. The CDC also provides useful information on the rates and incidents of minor and major pesticide related illnesses in agricultural settings.

State Talking Points

Further research was conducted on Washington State, Maryland, Oregon, and New York. The information was complied into talking points that can be accessed by lobbyist (See Appendix F). The talking points consist of chlorpyrifos monitoring data, incident information, use near schools, autism rates in the state, graphs and comments submitted by the agricultural industry in each states. In Washington State the county with the highest use of chlorpyrifos per pound, Yakima County, has the highest number of Hispanic residents of any county in the state, at 48.3% (The United States Census Bureau, n.d.). Some of Washington's top agricultural commodities included the top crops grown in the U.S, which are treated with chlorpyrifos (See Table 1). Four individual graphs were created to provide a visual representation of chlorpyrifos use on top commodities when compared to the U.S. EPA's 2014 Acute and Steady State Dietary Exposure Analysis. As mentioned above, in 2016 the U.S. EPA found no acceptable levels of chlorpyrifos in water, yet chlorpyrifos contamination has been found across the nation (U.S. Environmental Protection Agency, 2016b). In Washington State multiple studies indicate the alarmingly high levels of chlorpyrifos in the water, tables were constructed for states, which indicate the drinking water level of concern for chlorpyrifos for women and children. Charts were created for states, which had data available for air monitoring, water contamination, and food contamination (See Table 2).

Apple Results

Data was compiled for specific commodities, which will prove useful when attempting to influence change within the market. Apples are the top commodity sold across the U.S. with the highest rates of chlorpyrifos used per crop. A rough fact sheet was created with information on apple consumption in the U.S. by demographic, chlorpyrifos residues on apples, the U.S. EPA's dietary analysis of chlorpyrifos, and the top apple producing states (See Appendix G). In 2014 the average American consumed almost 12 pounds of apples, with children under the age of 6 consuming the highest quantities of all fruits (Produce for Better Health Foundation, 2015; U.S. Department of Agriculture, 2016). In 2015 the USDA Pesticide Data Program found 84% of apple acerage was treated with some form of chemical; additionally 48 pesticide residues were found on apples, chlorpyrifos was among these (U.S. Department of Agriculture, 2017a) (See Appendix H). The U.S. EPA's Acute and Steady State Dieatary Analysis found 55% of apples in the U.S. are treated with chlorpyrifos (U.S. Environmental Protection Agency, 2014) (See Figure 2).

Alternatives Results

Since many of the U.S. EPA's recommended alterntives to chlorpyrifos are just as dangerous, the NRDC is advocating for organic crops. A study conducted in 2008 found that 91% of the children tested had evidence of organophosphate pesticde exposure in their bodies (Lu et al., 2008). The study found that when children with conventional diets switched to eating organic produce the levels of chlorpyrifos in the body fell significantly. Studies conducted on American spending habits found that spending on organic foods has been steadly increaing, in fact in 2011 33% of teens reported eating organic foods that number rose in 2014 to 41% (Wissink et al., 2015). This information is significant because it illustrates the trend in America towards organic foods, and how teens are a driving force behind the demand for organic foods.

Implications

The studies conducted on chlorpyrifos persistence in the air, water and body, which indicate the harmful effects of exposure to the organophosphate on pregnanat women and children, demands a need for policy reform surrounding the use of chlorpyrifos on all food crops. The data collected and materials created provide ample evidece as to the need for policy reform, due to the current political climate this change will need to oocur on individual state levels. This can be achieved by spkeaing with state representatives and swaying the market and public opinoin as to the use of chlorpyrifos on all food products. On March 29th, 2017 the head of the U.S. EPA Scott Pruitt anounced that the petition, filled by PANNA and the NRDC in 2007, would be denied until further research could be conducted indicating the harmful effects of chlorpyrifos. Pruitt stated that the U.S. EPA's 2016 Revised Risk Asesement (which indicated that the EPA would support a revocation of all food uses of chlorpyrifos), was not based on sound science and that more studies need to be conducted that were free of bias. According to the statement chlorpyrifos will not be revisited until 2020. As illustrated in Appendix 3 there have been countless studies conducted on chlorpyrifos, across the world, and aside from a handful the majority of these studies found adverse health effects associated with chlorpyrifos exposure. Yet, in order pass a federal ban on chlorpyrifos it appears as though more studies must be conducted to further illustrate the harmful effects of this pesticide. Additional research needs to be conducted on the chronic effects of chlrpyrifos exposure to agricultural communities. It is difficult to study chronic exposures and even harder to isolate the effects of just one pesticide on the body, especially since agricultural communities are exposed to hundreds of pesticides daily. Additionally it would be difficult to know if further studies would make a difference in influencing the current administrations stance on chlodpyrifos use. Research that could prove useful in swaying public and governmental opinion on chlopyrifos use includes further biomonitoring studies conducted in non-agricultural regions of the U.S.. Such studies would help illustrates how residues on food and water contamination can effect even those not living in agricultural communties. These studies would also help dispeal the current government and agricultural indisturties claims that chlorpyrifos is only harmful to those who may suffer from acute poisonings.

The fight to revoke all uses of chlorpyrifos began over twenty years ago, in 2001 a victory occurred when the U.S. EPA banned most household uses of chlorpyrifos. Unfortunately, revoking the use of chlorpyrifos on agricultural food crops has proven to be extremely difficult. In order to continue fighting for a ban on chlorpyrifos coalitions must be maintained and expanded. The coalitions must continue to draw national attention to the harmful effects of chlorpyrifos and highlight the enviornemntal injustice surrounding the conitnued exposure of this pesticide, especially in such high concentrations, in agricultural communtines, which tend to be low income and largely Hispanic. An essential part of expanding these coalitions would be to incorporate agricultural communities and workers into these coalitions, these individuals could diseminate the information to fellow workers and neighrbors and empower the communities most effected by chlorpyrifos use. Currently, the majority of the organizations involved in the various pesticide reform coalitions are organizations based in San Francisco and Oakland, it is essential that we mibilize the local communities most effected and provide them with the knowledeg to advocate for themselves. A key role of these colations would be to conduct media campaigns that would generate public awareness surrounding the risks associated with chlorpyrifos exposure, both on agricultural communities and to the general population through pesticide residues. These campaigns could utilize social media and the news, to highlight the shocking effects of chlorpyrifos exposure. There have been multiple articles written in major publications indicating the harmful effects of chlorpyrifos; television could be a useful tool in disseminating this information to the general public. This could be done by holding rallies in local affected communities and collaborating with major food corporations, through campaigns to discontinue using crops treated with chlorpyrifos.

The science is clear in order to ensure a healthy future for our children we must revoke all food uses of chlorpyrifos on the federal level. It is imperative that on the local and state levels chlorpyrifos uses continue to be restricted and ideally banned, in key progressive states. The first step would be to petition the court to order the U.S. EPA to accept the petition to revoke the use of chlorpyrifos on food crops, based on the science and clear indication that it is harmful for agricultural communities. The next steps would be to influence the market and general perception on the use of chlorpyrifos. This could be achieved by influencing public opinion on the continued use of chlorpyrifos and driving demand for chlorpyrifos free crops up, which push policy makers to grant a ban on the use of the pesticide. The most likely scenario would be to petition independent key, progressive states to ban all food uses of chlorpyrifos. One of the main states targeted would be California, 1/5 of chlorpyrifos applied in the U.S. is used in this state, and there are ample studies indicating the persistence of chlorpyrifos in the environment. Coalitions must come together to influence policy makers and key governmental departments in the state. The resources gathered during the internship will be helpful tools, which the NRDC can draw upon. The current Governor of California, Jerry Brown, made it clear that California would continue to be a progressive state putting the safety of its people and the environment before Trump’s dangerous agenda. At a time like this it is imperative that Governor Brown make good on his promise to all Californians and revoke all food uses of chlorpyrifos.

Conclusion

Chlorpyrifos is a toxic pesticide, which poses significant risk to children's health; a ban on chlorpyrifos is needed to protect our children and pregnant women. Chlorpyrifos is an organophosphate insecticide, which kills insects by affecting the function of their nervous system (Tomlin, 2004). Developed during WWII the insecticide was initially used as a nerve gas agent, in 1965 it became a pesticide regularly used in agricultural and non-agricultural settings (Lein & Fryer, 2005; U.S. Environmental Protection Agency, 2016a). In 2017 the U.S. EPA denied a petition to revoke all food uses of chlorpyrifos, an act that would have protected our food and water from pesticide contamination. The U.S. EPA's decision comes in strict contrast to the 2001 ban of almost all residential uses of chlorpyrifos in the U.S. (U.S. Environmental Protection Agency, 2016a). Coalitions must work together to generate awareness towards the harmful effects of chlorpyrifos and revoke its use in key states.

Low- level exposure to chlorpyrifos during childhood, infancy and pregnancy has been linked to lifelong effects such as autism, ADHD, developmental delays and lower IQ (V. Rauh et al., 2011; V. A. Rauh et al., 2006; R. M. Whyatt et al., 2005). Children are at increased risk of exposure to the harmful chemical by playing on the floor and in the dirt, putting things in their mouths and eating lots of fruits and vegetables (Bradman et al., 2005). Pregnant women are at increased risk of exposure, as chlorpyrifos is able to penetrate the placental barrier impacting the neurological devolvement of the fetus (Eskenazi et al., 2007). Individuals living in agricultural regions are at increased risk of exposure and suffer far worse consequences. The U.S. EPA found that agricultural communities face the greatest risk due to worker exposure and air contamination (U.S. Environmental Protection Agency, 2016c). Pregnant women living within one mile of agricultural regions treated with chlorpyrifos during their second trimester of pregnancy have children born with autism at three times the rate of the general population (Hertz-Picciotto et al., 2006). Exposure to chlorpyrifos can also occur through consumption of pesticide residues on food crops treated with chlorpyrifos. Studies have found that children who consume conventional diets have higher levels of chlorpyrifos in their bodies then those who consumed organic foods (Curl et al., 2003; MacIntosh et al., 2001). The U.S. EPA's revised risk assessment states that due to exposure from pesticide food residues there are no safe levels of chlorpyrifos in drinking water, this is cause for concern as chlorpyrifos contamination has been detected in drinking water across all 50 states (U.S. Environmental Protection Agency, 2014, 2016b). Over 5 million pounds of chlorpyrifos is applied annually to agricultural fields across the Unites States, exposing countless individuals to unsafe levels of this toxic pesticide (U.S. Geological Survey, 2014).

My fieldwork project at the NRDC, within the Health Program at the San Francisco office, was to: complete analyses and create science, policy and communications materials to support health protective policies for the organophosphate pesticide chlorpyrifos in the market and at the federal and state levels. Research and literature reviews were conducted to compile state specific information on chlorpyrifos use and its effects on individual key states. This information was delivered as spreadsheets and select talking points. Information was complied to create a general chlorpyrifos fact sheet that was presented to senators in D.C. after the U.S. EPA's ruling to deny the ban of chlorpyrifos was announced. This fact sheet will be used by the NRDC when speaking with purveyors, governmental agencies and policy makers. Research and data analysis was conducted on the use of chlorpyrifos on apple crops; this information will be used to convince individual retailers to stop selling food crops, which were potentially treated with chlorpyrifos. A list of the U.S. EPA's recommended alternatives was compiled and assessed for toxicity and efficacy. This list will be used to illustrate how the safest alternative to chlorpyrifos treated crops is organic produce.

The U.S EPA announced its decision to deny the petition, presented by the NRDC and PANNA, to revoke all food crop uses of chlorpyrifos, on March 29th, 2017. The director of the U.S. EPA, Scott Pruitt, stated that the agency would not revisit chlorpyrifos until 2022. Public health advocates and coalitions must work together to revoke all uses of this pesticide on agricultural crops. Coalitions must include individuals in agricultural communities that are directly impacted by the use of chlorpyrifos in agricultural regions. The NRDC and PANNA must first sue the U.S EPA to appeal the government's decision and implement a court-imposed ban on chlorpyrifos. Litigators could cite the U.S EPA's own science, which in 2016 stated that there are no safe levels of chlorpyrifos in water and food crops, for children and pregnant women. Advocates and coalitions must also generate public awareness of this harmful chemical in the market and influence consumer demand. One way to do this would be to fund more epidemiological studies, which indicate the harmful effects of chlorpyrifos associated with chronic exposures in agricultural workers and children exposed through pesticide residues on food. Most importantly coalitions must work together to hold senators accountable for the health of their constituents by revoking all uses of chlorpyrifos on food crops in key progressive states.

References

Bouchard, M. F., Chevrier, J., Harley, K. G., Kogut, K., Vedar, M., Calderon, N., … Eskenazi, B. (2011). Prenatal Exposure to Organophosphate Pesticides and IQ in 7-Year Old Children. *Environmental Health Perspectives*, *1003185*(April). https://doi.org/10.1289/ehp.1003185

Bradman, A., Eskenazi, B., DB, B., Bravo, R., Castorina, R., Chevrier, J., … TE, M. (2005). Organophosphate urinary metabolite levels during pregnancy and after delivery in women living in an agricultural community. *Environmental Health Perspectives*, *113*(12), 1802–1807 6p. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=c8h&AN=106265834&site=ehost-live

Centers for Disease Control and Prevention. (2017). National Environmental Public Health Tracking Network Query Tool. Retrieved April 13, 2017, from https://ephtracking.cdc.gov/DataExplorer/

Curl, C. L., Fenske, R. A., & Elgethun, K. (2003). Organophosphorus pesticide exposure of urban and suburban preschool children with organic and conventional diets. *Environmental Health Perspectives*, *111*(3), 377–82. https://doi.org/10.1289/ehp.5754

Erickson, B. E. (2016). EPA reaffirms plan to ban chloryrifos on food: Agency cites concerns about neurotoxicity of organophosphate insecticide. *Chemical and Engineering News*, *94*(46), 16. Retrieved from http://cen.acs.org/articles/94/i46/EPA-reaffirms-plan-ban-chlorpyrifos.html?type=paidArticleContent

Eskenazi, B., Marks, A. R., Bradman, A., Harley, K., Barr, D. B., Johnson, C., … Jewell, N. P. (2007). Organophosphate pesticide exposure and neurodevelopment in young Mexican-American children. *Environmental Health Perspectives*, *115*(5), 792–798. https://doi.org/10.1289/ehp.9828

Fenske, R. A., Lu, C., Barr, D., & Needham, L. (2002). Children's exposure to chlorpyrifos and parathion in an agricultural community in central Washington State. *Environmental Health Perspectives*, *110*(5), 549–553. https://doi.org/10.1289/ehp.02110549

Hertz-Picciotto, I., Croen, L. A., Hansen, R., Jones, C. R., van de Water, J., & Pessah, I. N. (2006). The CHARGE study: an epidemiologic investigation of genetic and environmental factors contributing to autism. *Environmental Health Perspectives*, *114*(7), 1119–25. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/16835068

Hladik, M. L., Vandever, M., & Smalling, K. L. (2016). Exposure of native bees foraging in an agricultural landscape to current-use pesticides. *Science of The Total Environment*, *542*(Pt A), 469–477. https://doi.org/10.1016/j.scitotenv.2015.10.077

Lein, P. J., & Fryer, A. D. (2005). Organophosphorus insecticides induce airway hyperreactivity by decreasing neuronal M2 muscarinic receptor function independent of acetylcholinesterase inhibition. *Toxicological Sciences*, *83*(1), 166–176. https://doi.org/10.1093/toxsci/kfi001

Lu, C., Barr, D. B., Pearson, M. a, & Waller, L. a. (2008). Dietary Intake and Its Contribution to

Longitudinal Organophosphorus Pesticide Exposure in Urban / Suburban Children. *Environmental Health Perspectives*. https://doi.org/10.1289/ehp.10912

MacIntosh, D. L., Kabiru, C., Echols, S. L., & Ryan, P. B. (2001). Dietary exposure to chlorpyrifos and levels of 3,5,6-trichloro-2-pyridinol in urine. *Journal of Exposure Analysis and Environmental Epidemiology*, *11*, 279–285. https://doi.org/10.1038/sj.jea.7500167

Natural Resources Defense Council. (2017). About Us | NRDC. Retrieved April 12, 2017, from https://www.nrdc.org/about

Produce for Better Health Foundation. (2015). State of the Plate: 2015 Study on America's Consumption of Fruit & Vegetables. Retrieved from http://www.pbhfoundation.org/pdfs/about/res/pbh_res/State_of_the_Plate_2015_WEB_Bookmarked.pdf

Rao, P. S. C., Mansell, R. S., Baldwin, L. B., & Laurent, M. F. (2012). Pesticides and thier Behavior in Soil and Water. Retrieved April 12, 2017, from http://psep.cce.cornell.edu/facts-slides-self/facts/gen-pubre-soil-water.aspx

Rauh, V. A., Garcia, W. E., Whyatt, R. M., Horton, M. K., Barr, D. B., & Louis, E. D. (2015). Prenatal exposure to the organophosphate pesticide chlorpyrifos and childhood tremor. *NeuroToxicology*, *51*, 80–86. https://doi.org/10.1016/j.neuro.2015.09.004

Rauh, V. A., Garfinkel, R., Perera, F. P., Andrews, H. F., Hoepner, L., Barr, D. B., … Whyatt, R. W. (2006). Impact of prenatal chlorpyrifos exposure on neurodevelopment in the first 3 years of life among inner-city children. *Pediatrics*, *118*(6), e1845-59. https://doi.org/10.1542/peds.2006-0338

Rauh, V., Arunajadai, S., Horton, M., Perera, F., Hoepner, L., Barr, D. B., & Whyatt, R. (2011). Seven-year neurodevelopmental scores and prenatal exposure to chlorpyrifos, a common agricultural pesticide. *Environmental Health Perspectives*, *119*(8), 1196–1201. https://doi.org/10.1289/ehp.1003160

The United States Census Bureau. (n.d.). UNITED STATES QuickFacts from the US Census Bureau. Retrieved March 20, 2017, from https://www.census.gov/quickfacts/table/PST045216/00

Tomlin, C. (ed. . (2004). The e-Pesticide Manual, 13th ed. *BCPC Publications, Alton, Hants, UK.*

Tuttle, G. (2015). *Surface Water Monitoring Program for Pesticides in Salmonid-Bearing Streams, 2014 Data Summary*. Retrieved from http://agr.wa.gov/FP/Pubs/docs/104-494SWM2014Report.pdf

U.S. Department of Agriculture. (2016). National Agricultural Statistics Service - Charts and Maps - Apples: Utilized Production by Year, US. Retrieved March 3, 2017, from https://www.nass.usda.gov/Charts_and_Maps/Noncitrus_Fruits/histupap.php

U.S. Department of Agriculture. (2017a). PDP Databases and Annual Summaries | Agricultural Marketing Service. Retrieved March 3, 2017, from https://www.ams.usda.gov/datasets/pdp/pdpdata

U.S. Department of Agriculture. (2017b). USDA/NASS QuickStats Ad-hoc Query Tool. Retrieved March 3, 2017, from https://quickstats.nass.usda.gov/#A7BAD1E7-E7C4-3657-B1BA-3182B1B4F0E2

U.S. Environmental Protection Agency. (1996). Quality criteria for water. *Postharvest Biology and Technology*, *8*(3), 237–238. https://doi.org/10.1016/0925-5214(96)90008-3

U.S. Environmental Protection Agency. (2014). Chlorpyrifos: Acute and Steady State Dietary (Food Only) Exposure Analysis to Support Registration Review. Retrieved from https://www.regulations.gov/document?D=EPA-HQ-OPP-2008-0850-0197

U.S. Environmental Protection Agency. (2015). *Analysis of the Small Business Impacts of Revoking Chlorpyrifos Food Tolerances*. Retrieved from https://www.regulations.gov/document?D=EPA-HQ-OPP-2015-0653-0437

U.S. Environmental Protection Agency. (2016a). Chlorpyrifos: Ingredients Used in Pesticide Products. Retrieved from https://www.epa.gov/ingredients-used-pesticide-products/chlorpyrifos

U.S. Environmental Protection Agency. (2016b). Chlorpyrifos: Refined Drinking Water Risk Assessment for Registration Review. Retrieved from https://www.regulations.gov/document?D=EPA-HQ-OPP-2015-0653-0437

U.S. Environmental Protection Agency. (2016c). Chlorpyrifos: Revised Human Health Risk Assessment for Registration Review. Retrieved from https://www.regulations.gov/document?D=EPA-HQ-OPP-2015-0653-0454

U.S. Geological Survey. (2014). Pesticide Use Maps. Retrieved from https://water.usgs.gov/nawqa/pnsp/usage/maps/show_map.php?year=2014&map=CHLORPYRIFOS&hilo=L

USGS. (2017). USGS NAWQA: The Pesticide National Synthesis Project. Retrieved March 20, 2017, from https://water.usgs.gov/nawqa/pnsp/usage/maps/county-level/

Washington State Department of Agriculture Pesticide Management Division. (2016). *2015 Annual Report to the Legislature*. Retrieved from http://app.leg.wa.gov/ReportsToTheLegislature/Home/GetPDF?fileName=508-FY15-PMDAnnualReport_e945c0d2-3c89-48be-a607-d2ce218c5156.pdf

Whyatt, R. M., Camann, D. E., Kinney, P. L., Reyes, A., Ramirez, J., Dietrich, J., … Perera, F. P. (2002). Residential pesticide use during pregnancy among a cohort of urban minority women. *Environmental Health Perspectives*, *110*(5), 507–514. https://doi.org/10.1289/ehp.02110507

Whyatt, R. M., Camann, D., Perera, F. P., Rauh, V. A., Tang, D., Kinney, P. L., … Barr, D. B. (2005). Biomarkers in assessing residential insecticide exposures during pregnancy and effects on fetal growth. In *Toxicology and Applied Pharmacology* (Vol. 206, pp. 246–254). https://doi.org/10.1016/j.taap.2004.11.027

Wissink, S., Tamminga, N., Murphy, E., Naughton, S., Miller Regan, N., Munster, G., … Marsh, J. (2015). Taking Stock With Teens. Retrieved from http://www.kidsenjongeren.nl/wp-content/uploads/2014/10/Taking-Stock-Teach-In-Fall-2014.pdf

Table 1.

Abstraction from Washington State specific talking point

Washington State's Top Agricultural Crops of 2015, Treated with Chlropyrifos

Crop	Area Harvested (Acres)*	Value of Production (1,000 dollars)*	Chlorpyrifos Residue Detected**	Percent of U.S. Crop treated with Chlorpyrifos**
Apples	148,000	2,396,250	Yes	55%
Sweet Cherries	35,000	436,918	No	30%
Grapes	70,000	296,787	Yes	10%
Berries	22,700	252,436	Yes	20%
Pears	20,800	239,750	Yes	15%

References:

*Washington State Department of Agriculture & USDA (U.S. Department of Agriculture, 2017b; Washington State Department of Agriculture Pesticide Management Division, 2016)

**EPA 2014 Acute and Steady State dietary exposure analysis (U.S. Environmental Protection Agency, 2014)

Table 2.

Abstraction from Washington State specific talking points

Hypothetical DWLOC in children and women of reproductive age

(if there is no exposure to CPF from food residues etc.)

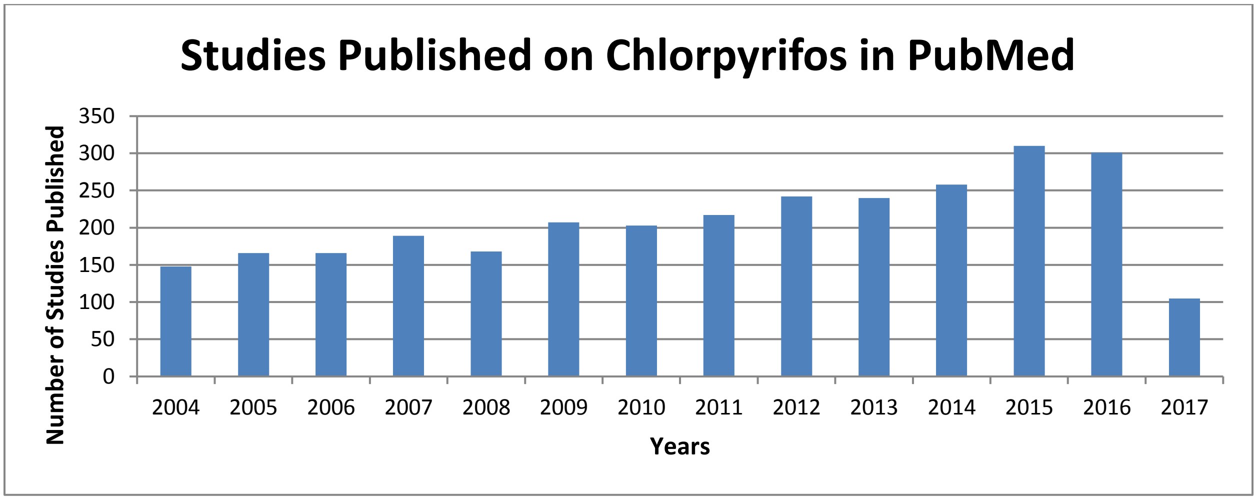
Study, Year	Population Subgroup	ssPoD$_{water}$* (µg/kg/day)	Hypothetical ssDWLOC** (µg/kg/day)	Water Exposure (µg/kg/day)	%ofssDWLOC
USGS NWQMC, 2017 (USGS, 2017)	Females (13-49 years old)	5.1	.051	.00317 Max concentration	6.2
	Young Children (1-2 years old)	3.2	.032	.00317 Max concentration	9.9
	Infants (<1 years old)	1.4	.014	.00317 Max concentration	22.6
Tuttle, 2015 (Tuttle, 2015)	Females (13-49 years old)	5.1	.051	.11 Average concentration	215.7
				2.1 Maximum concentration	4,117.6
	Young Children (1-2 years old)	3.2	.032	.11 Average concentration	343.8
				2.1 Maximum concentration	6,562.5
	Infants (<1 years old)	1.4	.014	.11 Average concentration	785.7
				2.1 Maximum concentration	15,000

*steady state point of departure (U.S. Environmental Protection Agency, 2016b)

**steady state drinking water level of concern= PoD÷ UF (Total uncertainty factor= 100x)

Figure 1.

Abstraction from graphs indicating studies published on PubMed on Chlorpyrifos



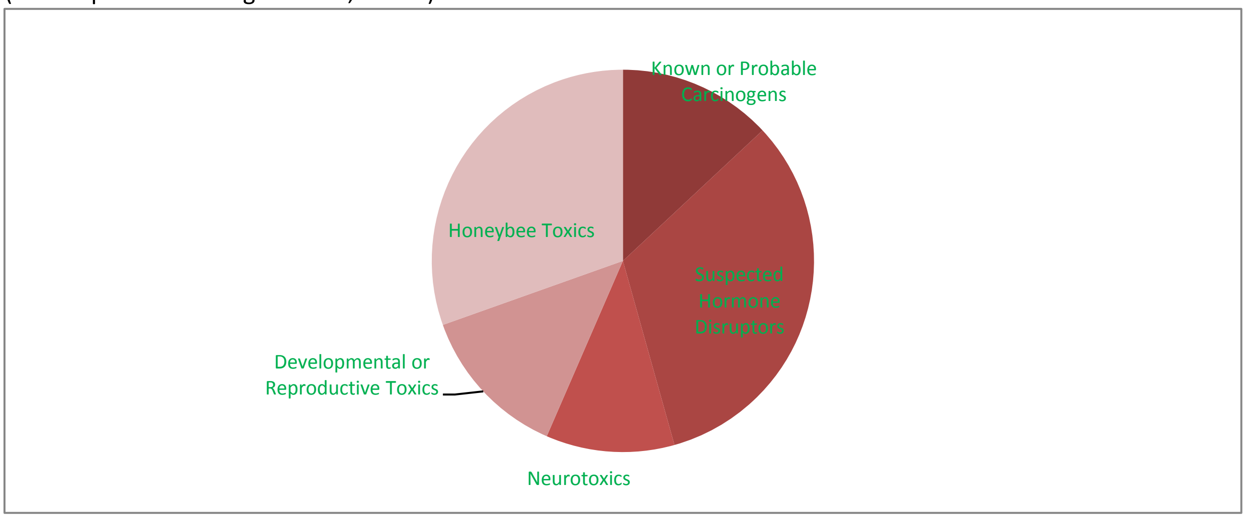
This chart illustrates the multitude of studies that have been conducted on chlorpyrifos, accessed from the database PubMed, from 2004- March 2017.

Figure 2.

Abstraction from draft of apple fact sheet, indicating the health effects associated with pesticides found by the USDA on apples.

Human and Environmental Health Effects of Pesticide Residues Found on Apples

(U.S. Department of Agriculture, 2017a)



This chart depicts the known toxicities of pesticides found on apples, as of March 2017

Appendix A

General Chlorpyrifos Fact Sheet

NRDC Fact Sheet

EPA must finalize ban of toxic pesticide chlorpyrifos to protect children's health

KEY FACTS

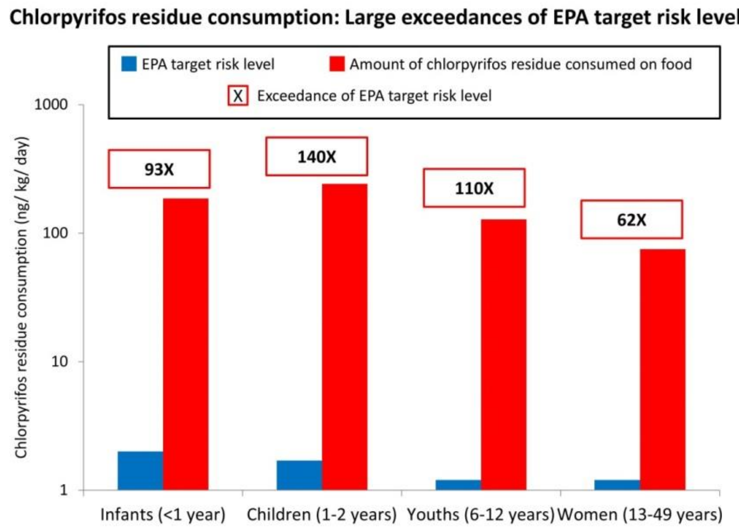
- **Chlorpyrifos is a toxic pesticide that poses significant risks to children's health.** Even low-level exposure during pregnancy is linked to lifelong effects such as autism, attention problems and lower IQ in children.
- **A ban is needed to protect our food and drinking water.** In November 2016, EPA found contamination of the food supply and drinking water at levels that threaten children's health across the country as well as increased risk to agricultural workers and communities.
- **EPA has proposed to ban all uses of chlorpyrifos for food crops.** EPA is under a court-ordered deadline to finalize the ban by March 31, 2017. Banning the use of chlorpyrifos would reduce human risk, leading to a healthier future for our children.

Comprehensive review of chlorpyrifos safety: risk to children necessitates ban

In November 2016, EPA released an updated chlorpyrifos safety assessment which addresses low-level exposures shown in multiple studies to disrupt brain development leading to developmental delays, lower IQ, autism and ADHD.[1–3] EPA found that use of chlorpyrifos on food crops resulted in unsafe exposures through contaminated food and drinking water. The assessment showed that agricultural communities face even greater risks due to worker exposure and air contamination. EPA's economic analysis indicates that there are readily available, feasible alternatives for virtually all chlorpyrifos uses.[4]

Unsafe chlorpyrifos residues contaminate the food supply

The EPA found that chlorpyrifos residues on food, including fruits and vegetables, are unsafe for pregnant women and children.[5] As shown in the graph, EPA's analysis found that residue exposures were far above their target risk level—in some cases, by up to 140 times! According to EPA's analysis, a ban of chlorpyrifos use on food is needed to make the food supply safe for pregnant women and kids.



Graph shows the EPA target risk level for chlorpyrifos residue consumption, compared to amounts of chlorpyrifos residue consumed on food, in nanograms per kilogram of body weight per day for infants, children and women[5]

Some of children's favorite fruits have widespread contamination with chlorpyrifos residues. The table illustrates chlorpyrifos residues and use patterns on select fruits.

Children's favorite fruits contaminated by chlorpyrifos

Fruit	Percent of whole fruit (not juice) in kids' diets	Chlorpyrifos residue detected	Percent of US crop treated with chlorpyrifos
Apples	36%	Yes	55%
Peaches/ Nectarines	7%	Yes	25%/10%
Citrus	9%	Yes	Oranges- 20%
Berries	8%	Yes	Strawberries-20%
Grapes	5%	Yes	10%
Melons	11%	Yes	<2.5%

Table shows fruits commonly consumed by children, detection of chlorpyrifos residues by the U.S. Department of Agriculture Pesticide Data Program testing, and the percent of the U.S. crop treated with chlorpyrifos.[6,7]

<u>EPA concluded there are no safe levels of chlorpyrifos in drinking water</u>

Chlorpyrifos enters water supplies primarily through spray drift and field runoff into ground and surface waters.[8] The U.S. EPA's risk assessment estimated that drinking water levels of the insecticide exceed the safe levels for consumption.[9] Drinking water across all 50 states is threatened with chlorpyrifos contamination

Background

Chlorpyrifos is an organophosphate insecticide widely used in agriculture, with over 5 million pounds of the insecticide applied annually across the U.S to a variety of crops including apples, oranges, broccoli and berries.[10] Widespread use has led to extensive water contamination and toxic residues on fruits and vegetables.[5] Due to risks to children's health, EPA banned household use in 2000.[10]

Early life exposure to pesticides is concerning because the developing brain is very susceptible to neurotoxic effects. Prenatal exposures, linked to a seven point reduction in IQ levels and reduced memory function in children, are of particular concern.[2,11] According to recent studies these effects appear to be irreversible and permanent.[12] A study conducted in 2008 found that 91% of children tested had evidence of organophosphate pesticide exposure in their bodies.[13]

Toxic residues = widespread health risks from food and water

EPA's assessment indicates that Americans are exposed to unsafe levels of chlorpyrifos through contaminated food and water. Recent studies raise concerns that exposure to chlorpyrifos could have lifelong effects on a child's brain health. Given these findings, it is unconscionable to allow the continued use of chlorpyrifos. The health of Americans cannot be put at risk simply from eating fruits and vegetables or drinking water from their tap. There must be a ban on chlorpyrifos to protect American families.

References

1. Rauh VA, Garfinkel R, Perera FP, et al. Impact of prenatal chlorpyrifos exposure on neurodevelopment in the first 3 years of life among inner-city children. *Pediatrics*. 2006;118(6):e1845-59. doi:10.1542/peds.2006-0338.

2. Bouchard MF, Chevrier J, Harley KG, et al. Prenatal Exposure to Organophosphate Pesticides and IQ in 7-Year Old Children. *Environ Health Perspect*. 2011;1003185(April). doi:10.1289/ehp.1003185.

3. Whyatt RM, Camann D, Perera FP, et al. Biomarkers in assessing residential insecticide exposures during pregnancy and effects on fetal growth. In: *Toxicology and Applied Pharmacology*. Vol 206. ; 2005:246-254. doi:10.1016/j.taap.2004.11.027.

4. U.S. Environmental Protection Agency. *Analysis of the Small Business Impacts of Revoking Chlorpyrifos Food Tolerances*.; 2015. https://www.regulations.gov/document?D=EPA-HQ-OPP-2015-0653-0437.

5. U.S. Environmental Protection Agency. Chlorpyrifos: Revised Human Health Risk Assessment for Registration Review. 2016. https://www.regulations.gov/document?D=EPA-HQ-OPP-2015-0653-0454.

6. Herrick K a., Rossen LM, Nielsen SJ, Branum a. M, Ogden CL. Fruit Consumption by Youth in the United States. *Pediatrics*. 2015;136(4):664-671. doi:10.1542/peds.2015-1709.

7. U.S. Environmental Protection Agency. Chlorpyrifos: Acute and Steady State Dietary (Food Only)

Exposure Analysis to Support Registration Review. https://www.regulations.gov/document?D=EPA-HQ-OPP-2008-0850-0197.

8. U.S. Environmental Protection Agency. Quality criteria for water. *Postharvest Biol Technol*. 1996;8(3):237-238. doi:10.1016/0925-5214(96)90008-3.

9. U.S. Environmental Protection Agency. Chlorpyrifos: Refined Drinking Water Risk Assessment for Registration Review. 2016. https://www.regulations.gov/document?D=EPA-HQ-OPP-2015-0653-0437.

10. U.S. Environmental Protection Agency. Chlorpyrifos: Ingredients Used in Pesticide Products. https://www.epa.gov/ingredients-used-pesticide-products/chlorpyrifos. Published 2016.

11. Rauh V, Arunajadai S, Horton M, et al. Seven-year neurodevelopmental scores and prenatal exposure to chlorpyrifos, a common agricultural pesticide. *Environ Health Perspect*. 2011;119(8):1196-1201. doi:10.1289/ehp.1003160.

12. Rauh VA, Garcia WE, Whyatt RM, Horton MK, Barr DB, Louis ED. Prenatal exposure to the organophosphate pesticide chlorpyrifos and childhood tremor. *Neurotoxicology*. 2015;51:80-86. doi:10.1016/j.neuro.2015.09.004.

13. Lu C, Barr DB, Pearson M a, Waller L a. Dietary Intake and Its Contribution to Longitudinal Organophosphorus Pesticide Exposure in Urban / Suburban Children. *Environ Health Perspect*. 2008;116(4):537-542. doi:10.1289/ehp.10912.

Appendix B

Table Indicating the EPA's Recommended Alternatives to Chlorpyrifos

Method/ Pesticide	Chemical Class	Use Type	Other
Abamectin	Botanical , Macrocyclic Lactone	Insecticide; Acaricide	
Acephate	Organophosphate	Insecticide	
Acetamiprid	Neonicotinoid	Insecticide	
Aldicarb	Carbamate	Insecticide; Acaricide; Nematicide	
Bacillus thuringiensis	Microbial	Insecticide	
Bifenthrin	Pyrethroid	Insecticide; Acaricide	
Buprofezin	Chitin Synthesis Inhibitor	Insecticide	
Carbaryl	Carbamate	Insecticide; Nematicid	
Chlorantraniliprole	Anthranilic Diamide	Insecticide	
Chlorethoxyfos	Organophosphate	Insecticide	
Clothianidin	Neonicotinoid	Insecticide	
Cryolite	Inorganic	Insecticide	
Cyfluthrin	Pyrethroid	Insecticide	
Deltamethrin	Pyrethroid	Insecticide	
Diazinon	Organophosphate	Insecticide	
Dicrotophos	Organophosphate	Insecticide; Acaricide	
Diflubenzuron	Benzamide	Insecticide	Insect Growth Regulator
Dimethoate	Organophosphate	Insecticide; Acaricide	
Disulfoton	Organophosphate	Insecticide; Acaricide	
Esfenvalerate	Pyrethroid	Insecticide	
Fenpropathrin	Pyrethroid	Insecticide; Acaricide	
Flonicamid	Unclassified	Insecticide	
Flubendiamide	Anthranilic Diamide	Insecticide	

Imidacloprid	Neonicotinoid	Insecticide	
Lambda-Cyhalothrin	Pyrethroid	Insecticide	
Malathion	Organophosphate	Insecticide	
Mating Disruption		Controls Insects	Pest Management Technique
Methomyl	Carbamate	Insecticide	
Methoxyfenozide	Diacylhydrazine	Insecticide	
Naled	Organophosphate	Insecticide; Acaricide	
Oxamyl	Carbamate	Insecticide; Acaricide; Nematicide	
Permethrin	Pyrethroid	Insecticide	
Petroleum Oil		Insecticide; Fungicide	Mineral/ Horicultural oil
Phorate	Organophosphate	Insecticide; Nematicid	
Phosmet	Organophosphate	Insecticide; Acaricide	
Pyriproxyfen	Juvenile Hormone Mimic	Insecticide	Insect Growth Regulator
Spinetoram	Spinosyn	Insecticide	
Spinosad	Spinosyn, Macrocyclic Lactone	Insecticide	
Spinosyn	Spinosyn, Macrocyclic Lactone	Insecticide	
Spirodiclofen	Tetronic acid/ Ketoenols	Insecticide; Acaricide	
Spirotetramat	Tetramic acid/ Ketoenols	Insecticide	
Sulfoxaflor	Sulfoximine	Insecticide	
Sulfur	Inorganic	Insecticide; Fungicide	
Tefluthrin	Pyrethroid	Insecticide	
Terbufos	Organophosphate	Insecticide; Nematicid	
Thiamethoxam	Neonicotinoid	Insecticide	
Zeta-Cypermethrin	Pyrethroid	Insecticide	

Appendix C

Compilation of Information and Graphs Illustrating the Studies Published in PubMed on Chlorpyrifos

Studies Published on Chlorpyrifos

Database: PubMed.gov

Date: March 28th, 2017

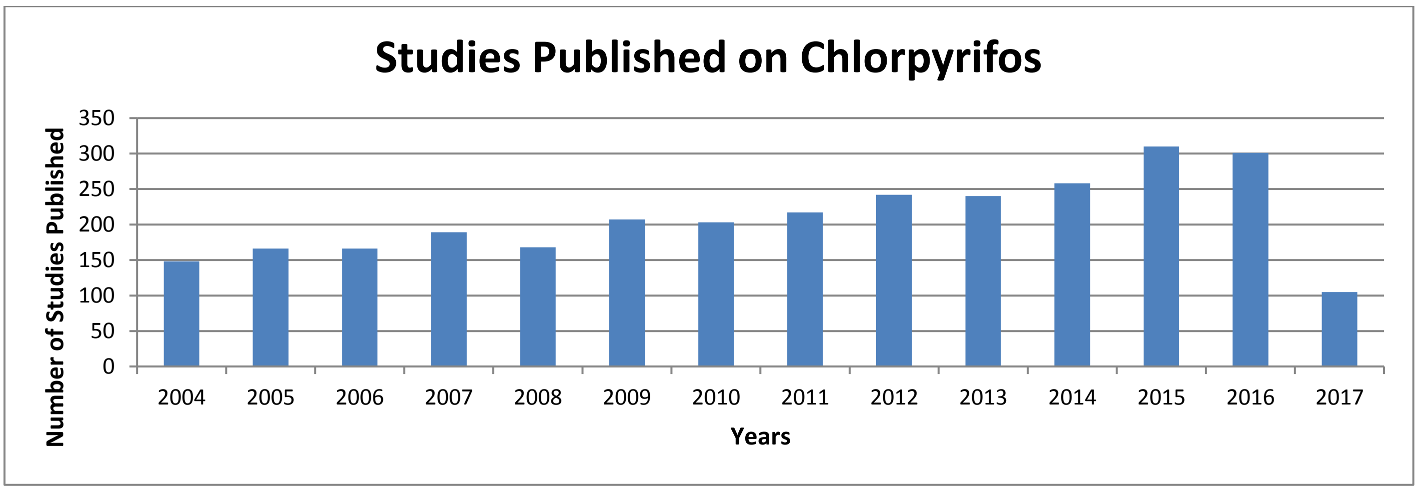
Keyword Searched: Chlorpyrifos

Filters: Article Types= Clinical Study & Clinical Trial

Publication Dates= From 2004/01/01- 2017/12/31

Total Number of Studies Published: 2920

From a quick glance: The most recently published studies were conducted outside the U.S.. It should be noted that some of these studies are in support of chlorpyrifos use, though the majority illustrate the risks associated with its use. Because this search is so broad some of the studies only briefly mention chlorpyrifos.



Studies Published on Chlorpyrifos Exposure

Database: PubMed.gov

Date: March 28th, 2017

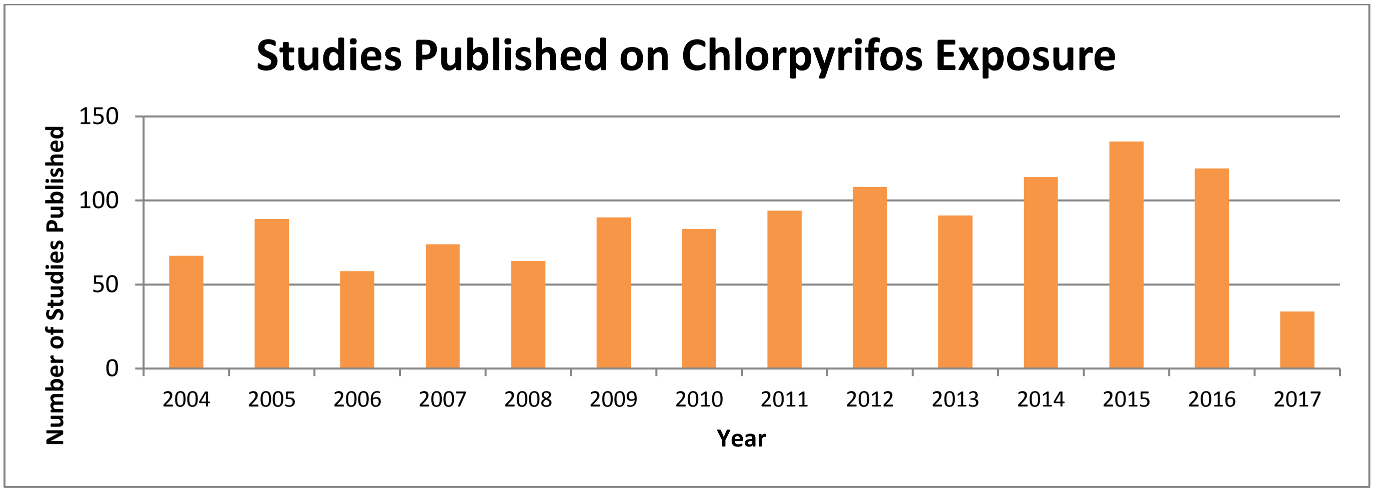
Keyword Searched: Chlorpyrifos Exposure

Filters: Article Types= Clinical Study & Clinical Trial

Publication Dates= From 2004/01/01- 2017/12/31

Total Number of Studies Published: 1220

From a quick glance: Because the search does not specify what kind of exposure, many of the studies include exposure to rats, aquatic life, and insects in addition to humans. The studies also range from exposure through food residues, proximity to pesticide use, and application of chlorpyrifos.



Studies Published on Chlorpyrifos Toxicity

Database: PubMed.gov

Date: March 28th, 2017

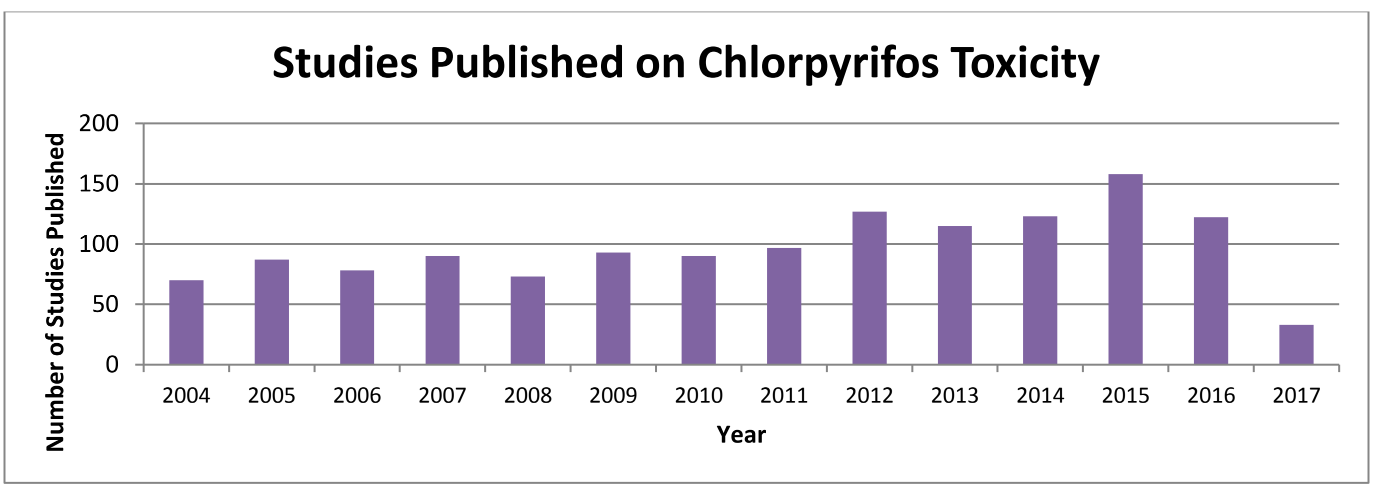
Keyword Searched: Chlorpyrifos Toxicity

Filters: Article Types= Clinical Study & Clinical Trial

Publication Dates= From 2004/01/01- 2017/12/31

Total Number of Studies Published: 1356

From a quick glance: The search is extremely broad, as such it includes studies on insects, aquatic life, mice, and humans. In many of the studies chlorpyrifos is one of multiple chemicals assessed.



Epidemiology Studies Published on Chlorpyrifos

Database: PubMed.gov

Date: March 28th, 2017

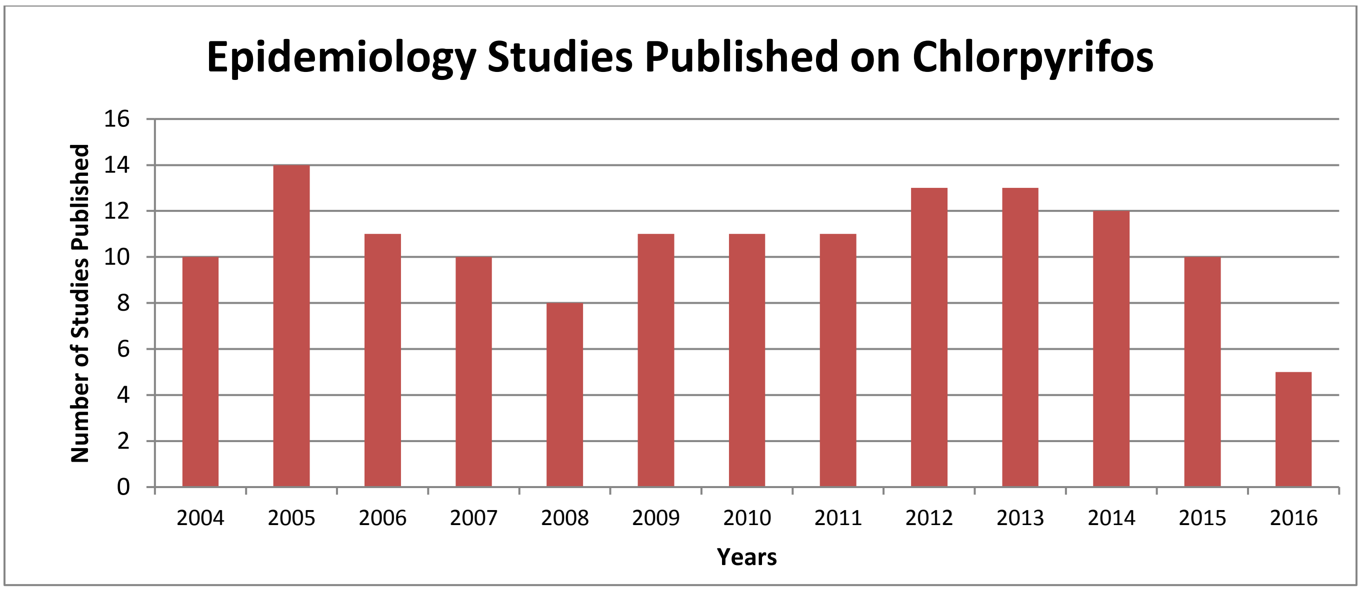
Keyword Searched: Chlorpyrifos, Epidemiology

Filters: Article Types= Clinical Study & Clinical Trial

Publication Dates= From 2004/01/01- 2016/12/31

Total Number of Studies Published: 139

From a quick glance: This search returns epidemiology studies conducted both in the United States and without. The studies include monitoring for clorpyrifos use in dust, urine and air, many of the studies were conducted on lab rats and mice.



Studies Published on the Health Effects of Chlorpyrifos

Database: PubMed.gov

Date: March 28th, 2017

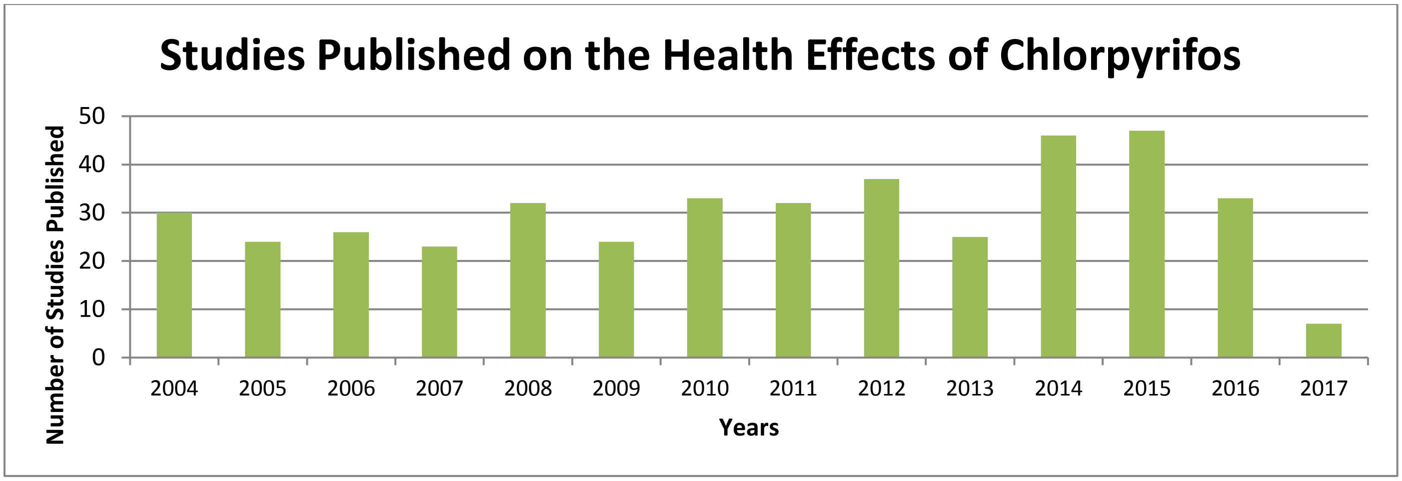
Keyword Searched: Chlorpyrifos Toxicity

Filters: Article Types= Clinical Study & Clinical Trial

Publication Dates= From 2004/01/01- 2017/12/31

Total Number of Studies Published: 419

From a quick glance: This search returned studies on the health effects of chlorpyrifos on rats, mice, insects, and humans. Some of the studies compare different methods of retrieving biomonitoring data for chlorpyrifos.



EPA's 2014 Revised Human Health Risk Assessment of Chlorpyrifos

Number of toxicological studies reviewed: 325 (pg 200-220)

References used for Toxicological studies of Pregnant Women:

24

References used for Toxicological studies of Fetuses, Infants, Toddlers & Young Children:

38

References used for Toxicological studies of Adverse Outcome Pathways: AChE Inhibition & Plausible Pathways Leading to Neurodevelopmental Outcomes:

2

References used for Toxicological studies of Initiating Event & Health Outcomes:

3

References used for Toxicological studies of Dose Response Analysis for AChE Inhibition:

2

References used for Toxicological studies of Summary of BMD Modeling Result:

12

References used for Toxicological studies of Acetylcholinesterase (AChE) as a morphogen:

53

References used for Toxicological studies of Endocannabinoid system:

25

References used for Toxicological studies of Reactive Oxygen Species:

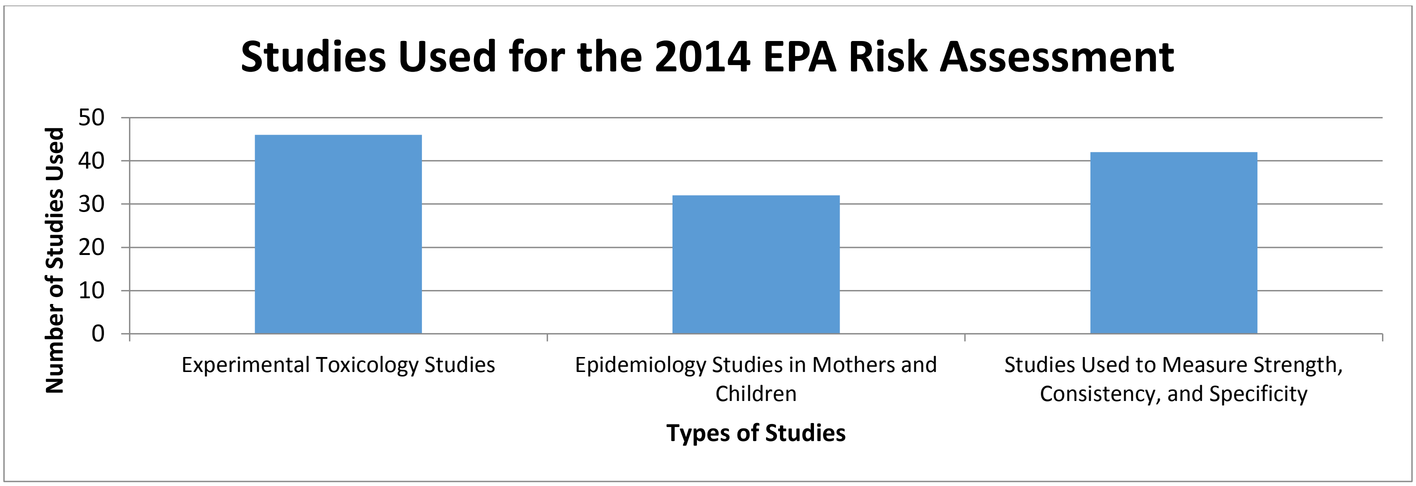
51

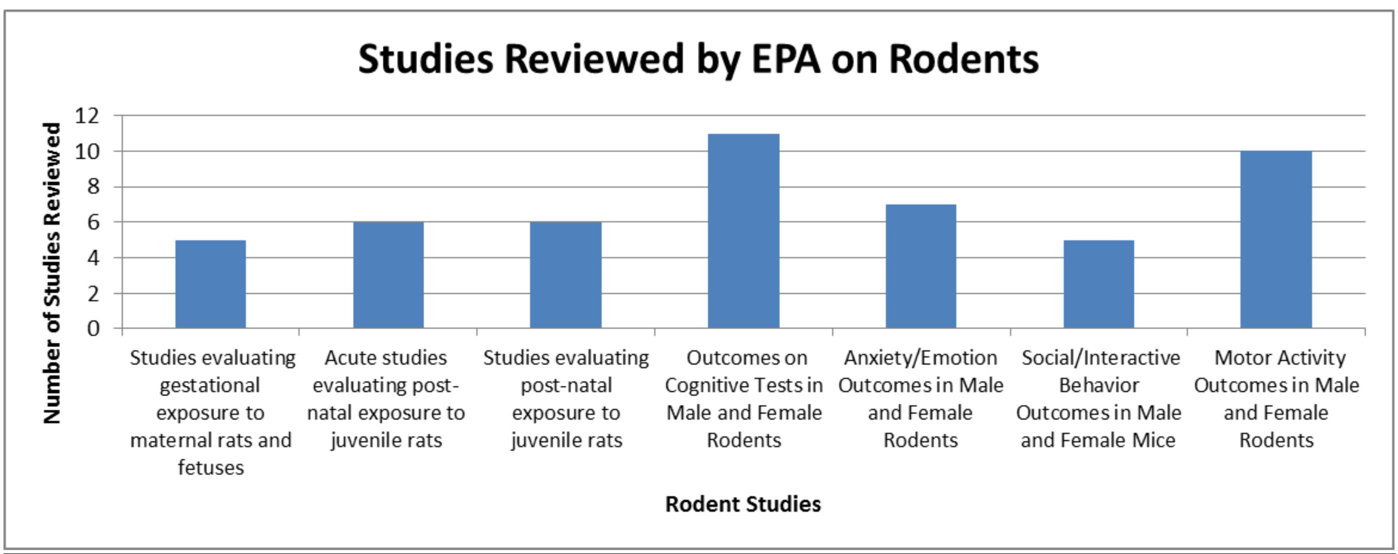
References used for Toxicological studies of Tubulin, Microtubule Associated Proteins and Axonal Transport:

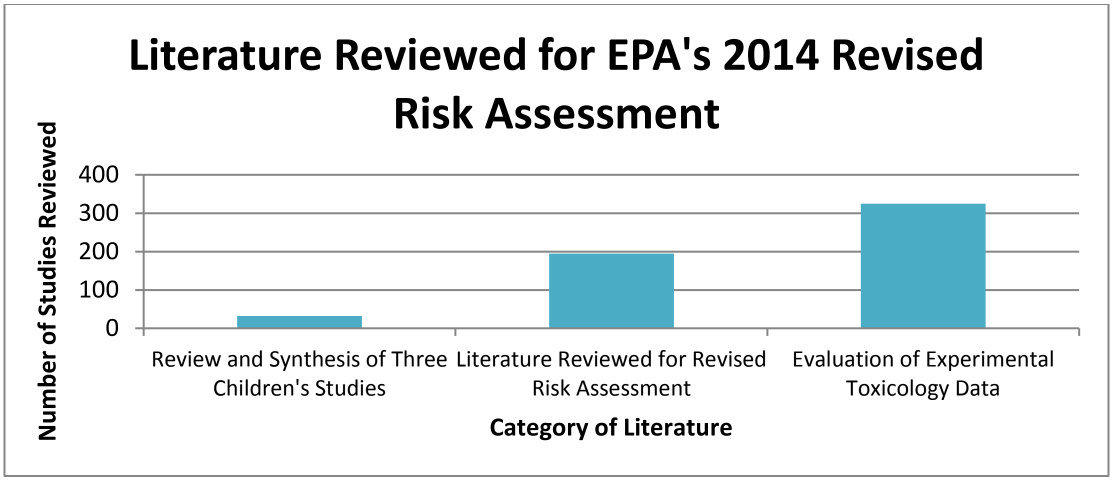
35

Number of studies reviewed on children's health: 32 (pg 250-252)

Number of studies used for chlorpyrifos overview and effects: 195 (pg 108-124)






Literature Reviewed for EPA's 2014 Revised Risk Assessment
Number of Studies Reviewed
400
300
200
100
0
Review and Synthesis of Three Children's Studies
Literature Reviewed for Revised Risk Assessment
Evaluation of Experimental Toxicology Data
Category of Literature

Appendix D

Abstraction of Information from the Top Priority State Spreadsheet

(Use Data, EPA's Drinking Water Analysis and Populations at Risk)

	Use data					Drinking Water	Populations at risk from food residues	
State	**Most recent year of use data**	**Pounds of Chlorpyrifos (EPest-High)**	**Source of data**	**Major Crops grown with chlorpyrifos**	**Source of data**	**EPA Drinking Water Analysis Average of 21-day average concentration (ug/L)- HIGH**	**Number of children under 5**	**Number of women of childbearing age**
CA	2014	1304413.26	USGS	Almonds Strawberries Walnuts Broccoli Cauliflower	USDA	398	2,531,333	9,224,706
WA	2015	327026.66	USGS	Apples Cherries Grapes Pears	USDA	347	439,657	1,602,106
OR	2015	100883.31	USGS	Pears Grapes Onions Hazelnuts	USDA	230	237,556	886,355
NY	2015	100028.80	USGS	Apples Cabbage Grapes Onion	USDA	426	1,155,822	4,797,187
DE	2015	7538.71	USGS	Wheat Sweet Corn	USDA	426	55,886	214,024
VT	2015	3687.01	USGS	Apples Sweet Corn	USDA	344	31,952	143,893
NM	2015	141509.44	USGS	Pecans Onions	USDA	513	144,981	472,007

MD	2015	18452.03	USGS	Apples Watermelon Cantaloupe Sweet Corn	USDA	426	364,488	1,433,018

Appendix E

Abstraction of Information from the Second Priority State Spreadsheet

(Use Data, EPA's Drinking Water Analysis and Populations at Risk)

	Use data					Drinking Water	Populations at risk from food residues	
State	**Most recent year of use data**	**Pounds of Chlorpyrifos**	**Source of data**	**Major Crops grown with chlorpyrifos**	**Source of data**	**EPA Drinking Water Analysis Average of 21-day average concentration (ug/L)- HIGH**	**Number of children under 5**	**Number of women of childbearing age**
RI	2015	337.97	USGS	Apples Sweet Corn	USDA	344	57,448	256,512
IL	2015	345711.28	USGS	Apples Peaches Sweet Corn	USDA	414	835,577	3,108,424
ME	2015	2374.16	USGS	Apples Sweet Corn	USDA	344	69,520	296,681
MT	2015	228135.67	USGS	Cherries Canola Wheat	USDA	571	62,423	215,457
MO	2015	293568.21	USGS	Apples Pecans Peaches Grapes	USDA	571	390,237	1,401,351
MI	2015	219608.41	USGS	Apples Asparagus Onion Peaches	USDA	406	596,286	2,295,428
MA	2015	1466.1	USGS	Apples Sweet Corn Peaches	USDA	344	367,087	1,614,073
CO	2015	203840.29	USGS	Sunflower Oats Peaches Sugar beets	USDA	513	338,308	1,735,627

Appendix F

State Specific Talking Points on Chlorpyrifos for Washington State, Oregon, Maryland and New York State

Washington State CPF Data

Bulleted Talking points

- In 2015 an estimated 327,026 pounds of Chlorpyrifos were used on Washington State fields, according to the USGS.[1]
- Children, below the age of 5, and pregnant women are most susceptible to the adverse effects of CPF. According to the latest United States census there are 439,657 children under 5 years of age and 1,602,106 women of childbearing age in Washington State.[2]
- Latinos account for 48.3% of the population, in Yakima Valley, while non- Hispanic whites make up 44.3% of the population. In 2015 19.1% of the population lived in poverty.[3]
- Yakima County is considered a distressed area county (three-year unemployment rate is at least 20% higher than the statewide average) with a three- year average unemployment rate of 8.9% from 2013-2015.[4]
- In 2015 the agriculture, forest and fishing sector accounted for 27.7% (30,191) of all jobs in Yakima County, the largest number of employees of any other sector.[4]

Biomonitoring data

- The Washington State Department of Health conducted a study from 2010-2011 where they assessed the impact of eating organic on the levels of CPF in the body, they did this by measuring the urinary chlorpyrifos metabolite (TCPy). The study found a 95th percentile of 5.25µg/L, for individuals who ate organic foods less than half the time in the last two days, and a 95th percentile of 2.68 µg/L, for individuals who ate organic foods always in the last two days. The study concluded that the difference in TCPy concentrations between the two cohorts may reflect chlopyrifos pesticide exposure from eating food with pesticide residue.[5]
- The Washington State Department of Public Health conducted a study from 2010-2011 which found the 95th pctl. creatinine-corrected mean concentration of TCPy in children 6-11 was 5.75µg/g, while the 95th pctl. creatinine-corrected mean concentration of TCPy in adults, 20+ was 4.02µg/g.[6]

Air and Water monitoring data

- A study found Yakima Valley, a top agricultural community in WA, monthly outdoor air concentrations of CPF ranged from 9.2-199ng/m^3. The highest level of CPF were detected in the Spring with a mean monthly outdoor air concentration of CPF for proximal farmworkers of 72 ng/m^3, and a mean monthly outdoor air concentration of CPF for non-proximal non-farmworkers of 11 ng/m^3. The mean monthly indoor air concentration of CPF for proximal farmworkers was 7.9 ng/m³, and the mean monthly indoor air concentration of CPF for non-proximal non-farmworkers was 0.6 ng/m³.[7]

- According to the National Water Quality Monitoring Data the statewide average concentrations of chlorpyrifos in all WA water rose from .08ng/l in 2015 to .13ng/l in 2016, with a maximum concentration of 3.17ng/l .[8]
- A study conducted in the Lower Yakima Valley, in 2016, found geometric mean CPF concentrations in household dust of farmworkers and non-farmworkers of 13ng/n and 1.5ng/n respectively.[9]

Estimated Drinking Water Concentrations of Chlorpyrifos Resulting from the Use of Chlorpyrifos on a Regional Basis

	1-in-10 day							
State	**24 hr average concentration (ug/L)- LOW**	**Exceedance of DWLOC**	**24 hr average concentration (ug/L)- HIGH**	**Exceedance of DWLOC**	**21-day average concentration (ug/L)- LOW**	**Exceedance of DWLOC**	**21-day average concentration (ug/L)- HIGH**	**Exceedance of DWLOC**
WA	1.55	111	593	42357	1.04	74	347	24786

Reference:

EPA Revised Drinking Water Assessment[10]

CPF use by schools

- The Washington State Urban Pesticide Education Strategy Team found, in 2015, more than 100 public schools (kindergarten- 12th grade) within 200 feet of agricultural operations and more than 200 public schools within one-quarter mile of agricultural operations. The extreme proximity of schools to agricultural fields poses risks to school staff and children to pesticide exposure, especially through drift.[11]
- According to the USGS in 2015 Yakima County had the highest use of chlorpyrifos in the state. This is cause for concern as Yakima County has over 53,000 students who attend over 150 child care centers and schools in the county.[12]
- Yakima County is the 18th largest county in the state. It is the largest Latino-majority district in the state, 77.1% of the students in the Yakima School District are of Hispanic origins. [12,13]

Incident Data

- In 2011 CPF accounted for 15.5% of all agricultural occupational definite, probably or possible cases.[14]
- In 2015 49% (61) of pesticide poisoning incidents, in WA, occurred in agricultural settings, 77% (47) of the incidents involved allegations of drift.[15]
- In 2014 the CDC reported occupational incidents through The National Environmental Public Health Tracking Network. There were 55 exposures to carbamates/ organophosphates and a .78 rate of pesticide exposure to carbamates/ organophosphates per 100,000 people (https://ephtracking.cdc.gov/DataExplorer/index.html?c=PE&i=-1&m=-1).

Autism in WA

- In 2003, 7.2% OF children ages 4-17 were ever diagnosed with ADHA in WA, by 2012-2013 that percentage grew to 9.8%.[16]

Pesticide drift problems continue despite lawsuits and proposed legislation by Kate Prengaman

This article touches on pesticide drift in the Yakima Valley, CPF is mentioned as well as the EPA proposed ban. There is a story about drift:

"While working in a Toppenish area hop field this spring, Adriana Flores and 46 other farm workers were sickened by wafting pesticides being sprayed on a neighboring alfalfa field.

"We were working when we saw the small plane, and there was a very strong smell of pesticides, but they told us to keep working," said Flores, 23. "One by one, we started feeling sick."

It hurt to breathe, she recalled, and then she felt sick to her stomach. The crew boss eventually called an ambulance and sent some workers to the hospital, but Flores wasn't one of them. The mother of two from Wapato feels mostly recovered now, but worries the exposure to unknown chemicals could have a lasting health effect."

(http://www.yakimaherald.com/news/local/pesticide-drift-problems-continue-despite-lawsuits-and-proposed-legislation/article_53e1621e-8db1-11e6-827a-4b7f2b4c5af5.html)

Tables comparing EPA level of Concern with WA studies

CPF air concentrations and the LOC for adults

Study, Year	Sampler/ Site Location	Maximum Air Concentration (ng/m^3)	Mean Air Concentration (ng/m^3)	Acute MOEs* (LOC=100)	Steady State MOEs** (LOC=100)
Gibbs, Yost, Negrete, & Fenske, 2016[7]	Spring, Outdoor proximal farmworker, Yakima Valley	199	72	20.1	2.9
	Spring, Indoor proximal farmworker, Yakima Valley	18	7.9	222.2	26.6
Lopez, Fenske, Negrete, & Palmendez, 2009[17]	Receptor 1, North Central Region	493.9	47.3	8.1	4.4
	Receptor 2, Yakima Valley Region	222.4	37.6	18	5.6

*Acute MOE= Acute PoD (4,000 ng/m^3)[18]/ Study maximum air concentration (ng/m^3).

**Steady State MOE= Steady State PoD (210 ng/m^3)[18]/ Study mean air concentration (ng/m^3).

CPF air concentration and the LOC for Children (1<2 years old)

Study, Year	Sampler/ Site Location	Maximum Air Concentration (ng/m^3)	Mean Air Concentration (ng/m^3)	Acute MOEs* (LOC=100)	Steady State MOEs** (LOC=100)
Gibbs, Yost, Negrete, & Fenske, 2016[7]	Spring, Outdoor proximal farmworker, Yakima Valley	199	72	6.5	9.4
	Spring, Indoor proximal farmworker, Yakima Valley	18	7.9	72.2	86.1
Lopez, Fenske, Negrete, & Palmendez, 2009[17]	Receptor 1, North Central Region	493.9	47.3	2.6	14.4
	Receptor 2, Yakima Valley Region	222.4	37.6	5.8	18.1

*Acute MOE= Acute PoD (4,000 ng/m^3)[18]/ Study maximum air concentration (ng/m^3).

**Steady State MOE= Steady State PoD (210 ng/m^3)[18]/ Study mean air concentration (ng/m^3).

Hypothetical DWLOC in children and women of reproductive age

(if there was no exposure to CPF from food residues etc.)

Study, Year	Population Subgroup	ssPoD$_{water}$* (μg/kg/day)	Hypothetical ssDWLOC** (μg/kg/day)	Water Exposure (μg/kg/day)	%ofssDWLOC
NWQMC, 2016[8]	Females (13-49 years old)	5.1	.051	.00317 Max concentration	6.2
	Young Children (1-2 years old)	3.2	.032	.00317 Max concentration	9.9
	Infants (<1 years old)	1.4	.014	.00317 Max concentration	22.6
Tuttle, 2015[19]	Females (13-49 years old)	5.1	.051	.11 Average concentration	215.7
				2.1 Maximum concentration	4,117.6
	Young Children (1-2 years old)	3.2	.032	.11 Average concentration	343.8
				2.1 Maximum concentration	6,562.5
	Infants (<1 years old)	1.4	.014	.11 Average concentration	785.7
				2.1 Maximum concentration	15,000

*steady state point of departure[18]

**steady state drinking water level of concern= PoD÷ UF (Total uncertainty factor= 100x)

<u>Table with top selling produce Vs. EPA risk assessment</u>

Washington State's Top Agricultural Crops of 2015, Treated with Chlropyrifos

Crop	Area Harvested (Acres)*	Value of Production (1,000 dollars)*	Chlorpyrifos Residue Detected**	Percent of U.S. Crop treated with Chlorpyrifos**
Apples	148,000	2,396,250	Yes	55%
Sweet Cherries	35,000	436,918	No	30%
Grapes	70,000	296,787	Yes	10%
Berries	22,700	252,436	Yes	20%
Pears	20,800	239,750	Yes	15%

References:

*Washington State Department of Agriculture & USDA[20]

**EPA 2014 Acute and Steady State dietary exposure analysis[21]

State Comments to attach:

Northwest Horticultural Council

The NHC represents the growers and shippers of apples, pears and cherries in Idaho, Oregon, and Washington. The NHC calls into question the validity of the EPA's Revised Drinking Water Risk Assessment. They also state that the use of CPF has reduced in recent years, and that the use of IPM techniques has increased.

The American Sugar Beet Growers Association

The American Sugar Beet Growers Association states that their crops would be decimated because there is 'no other practical non-chemical alternative available."

The Washington State Department of Agriculture

The WSDA request that if the ban does go through, the EPA allow at least 18 months for old products to move through the channels of trade and an additional 6 months for treated crops to move through distribution channels.

WA Friends of Farm and Forests

WA Friend of Farm and Forest state that CPF is the only effective tool to mitigate for mint root borer , and that the loss of CPF would be devastating since the number of insecticides registered for use on mint are extremely limited.

WA Potato Commission

The Potato Commission argues that revoking the use of CPF in agriculture will cause the development of pest resistance.

References

1. USGS. USGS NAWQA: The Pesticide National Synthesis Project. https://water.usgs.gov/nawqa/pnsp/usage/maps/county-level/. Published 2017. Accessed March 20, 2017.

2. The United States Census Bureau. UNITED STATES QuickFacts from the US Census Bureau. https://www.census.gov/quickfacts/table/PST045216/00. Accessed March 20, 2017.

3. The United States Census Bureau. Yakima County, Washington. https://www.census.gov/quickfacts/table/RHI725215/53077. Accessed March 20, 2017.

4. Employment Security Department: Washington State. Distressed Areas List. https://fortress.wa.gov/esd/employmentdata/reports-publications/regional-reports/distressed-areas-list. Published 2016. Accessed March 22, 2017.

5. Washington State Department of Public Health. Chlorpyrifos Pesticide (TCPy) Creatinine-

Corrected. http://www.doh.wa.gov/DataandStatisticalReports/EnvironmentalHealth/WashingtonTrackingNetworkWTN/Biomonitoring/90. Accessed March 3, 2017.

6. Washington State Department of Health. Chlorpyrifos Pesticide (TCPy) Creatinine-Corrected. http://www.doh.wa.gov/DataandStatisticalReports/EnvironmentalHealth/WashingtonTrackingNetworkWTN/Biomonitoring/88. Accessed March 20, 2017.

7. Gibbs JL, Yost MG, Negrete M, Fenske RA. Passive Sampling for Indoor and Outdoor Exposures to Chlorpyrifos, Azinphos-Methyl, and Oxygen Analogs in a Rural Agricultural Community. *Environ Health Perspect*. 2016;125(3). doi:10.1289/EHP425.

8. National Water Quality Monitoring Council. Water Quality Data. https://www.waterqualitydata.us/portal/. Accessed March 17, 2017.

9. Smith MN, Workman T, McDonald KM, et al. Seasonal and occupational trends of five organophosphate pesticides in house dust. *J Expo Sci Environ Epidemiol*. August 2016. doi:10.1038/jes.2016.45.

10. U.S. Environmental Protection Agency. Chlorpyrifos: Refined Drinking Water Risk Assessment for Registration Review. 2016. https://www.regulations.gov/document?D=EPA-HQ-OPP-2015-0653-0437.

11. Washington State Urban Pesticide Education Strategy Team. *Guidelines for Schools Next to Agricultural Operations*.; 2015. https://schoolipm.wsu.edu/documents/2015/09/guidelines-for-schools-next-to-agricultural-operations.pdf. Accessed March 20, 2017.

12. Yakima School District. District Profile / District Profile. https://www.yakimaschools.org/domain/13. Published 2017. Accessed March 20, 2017.

13. Home - West Valley School District #208. http://www.wvsd208.org/. Published 2017. Accessed March 20, 2017.

14. Washington State Department of Health. *Pesticide Data Report, Washington State, 2010-2011 Agency Data*.; 2013. http://www.doh.wa.gov/Portals/1/Documents/Pubs/334-319.pdf. Accessed March 20, 2017.

15. Washington State Department of Agriculture Pesticide Management Division. *2015 Annual Report to the Legislature*.; 2016. http://app.leg.wa.gov/ReportsToTheLegislature/Home/GetPDF?fileName=508-FY15-PMDAnnualReport_e945c0d2-3c89-48be-a607-d2ce218c5156.pdf. Accessed March 20, 2017.

16. Centers for Disease Control and Prevention. Prevalence | ADHD | NCBDDD | CDC. https://www.cdc.gov/ncbddd/adhd/prevalence.html. Published 2017. Accessed March 22, 2017.

17. Fenske R, Yost M, Galvin K, et al. *Organophosphorus Pesticide Air Monitoring Project - Final Report*.; 2009. http://www.doh.wa.gov/Portals/1/Documents/4300/Pesticide-UW-OP-Report.pdf. Accessed March 17, 2017.

18. U.S. Environmental Protection Agency. Chlorpyrifos: Revised Human Health Risk Assessment for

Registration Review. 2016. https://www.regulations.gov/document?D=EPA-HQ-OPP-2015-0653-0454.

19. Tuttle G. *Surface Water Monitoring Program for Pesticides in Salmonid-Bearing Streams, 2014 Data Summary*.; 2015. http://agr.wa.gov/FP/Pubs/docs/104-494SWM2014Report.pdf. Accessed March 17, 2017.

20. USDA, National Agricultural Statistics Service, Northwest Regional Field Office. *2016 Washington Annual Statistical Bulletin*.; 2016. https://www.nass.usda.gov/Statistics_by_State/Washington/Publications/Annual_Statistical_Bulletin/2016/annual 2016.pdf. Accessed March 20, 2017.

21. U.S. Environmental Protection Agency. Chlorpyrifos: Acute and Steady State Dietary (Food Only) Exposure Analysis to Support Registration Review. https://www.regulations.gov/document?D=EPA-HQ-OPP-2008-0850-0197.

Oregon CPF Data

Bulleted Talking points

- In 2015 an estimated 100,883 pounds of chlorpyrifos were used on Oregon fields, according to the USGS.[1]
- Children, below the age of 5, and pregnant women are most susceptible to the adverse effects of CPF. According to the latest United States census there are 237,556 children under 5 years of age and 886,355 women of childbearing age in Oregon.[2]
- Latinos account for 17.4% of the population, in Wasco County (one of the counties that uses the most CPF in Oregon), while non- Hispanic whites make up 75.3% of the population. In 2015 16% of the population lived in poverty.[3]

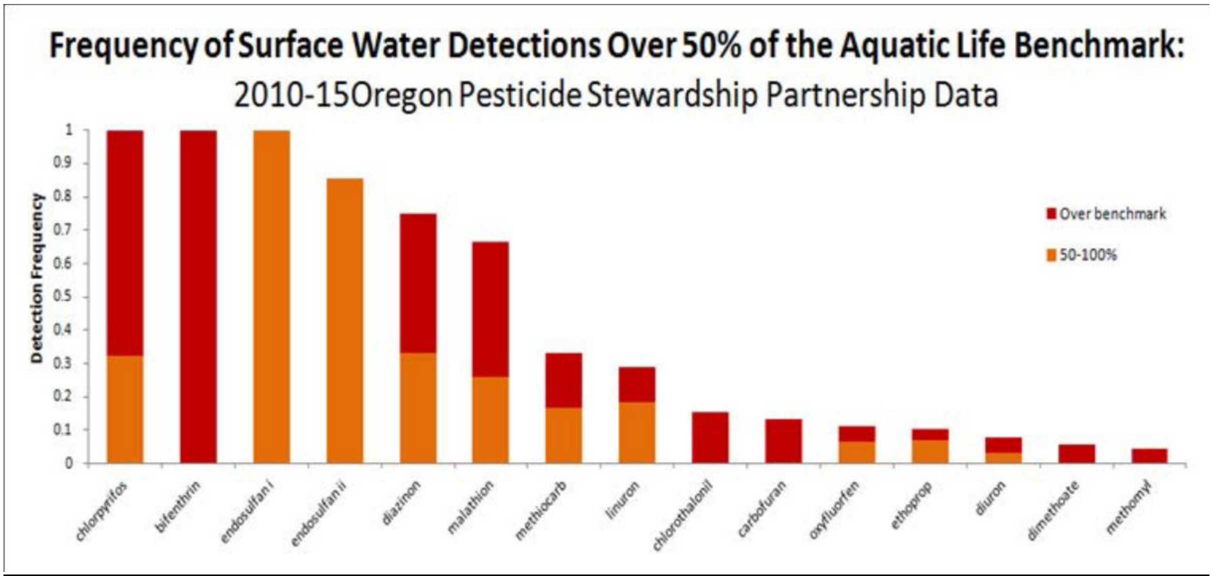
Biomonitoring data

- A study conducted in 2005 found a 7.2ng/mL geometric mean concentration of DMTP in children's urine, in Portland OR and a 38.54ng/mL geometric mean concentration of DMTP in children's urine, in Hood River OR.[4]

Air and Water monitoring data

- According to the National Water Quality Monitoring Data the statewide average concentration of chlorpyrifos in all OR water, in 2016, was 1.4ng/L and the maximum concentration was 66.1ng/L.[5]
- The Pesticide Stewardship Partnership Program measured CPF detections in Wasco County surface water from 2011-2015. The average concentration of CPF was 1.73ng/L and the maximum concentration was 81.5ng/L (e-mail correspondence with Kirk V. Cook).[6]
- The Pesticide Stewardship Partnership Program measured CPF detections in Umatilla County surface water from 2012-2015. The average concentration of CPF was 9.68ng/L and the maximum concentration was 348ng/L (e-mail correspondence with Kirk V. Cook).[6]

Reference:
Kirk V. Cook, RG
Pesticide Stewardship Partnership
Oregon Department of Agriculture
475 NE Bellevue Dr, Suite 110
Bend, OR 97701
(541) 841-0074
kcook@oda.state.or.us



Reference:

E-mail Correspondence with Kevin Masterson
Agency Toxics Coordinator
Oregon Department of Environmental Quality
475 NE Bellevue Drive, Ste 100
Bend, OR 97701
Ph. (541) 633-2005
masterson.kevin@deq.state.or.us

Estimated Drinking Water Concentrations of Chlorpyrifos Resulting from the Use of Chlorpyrifos on a Regional Basis

	1-in-10 year							
State	**24 hr average concentration (ug/L)- LOW**	**Exceedance of DWLOC**	**24 hr average concentration (ug/L)- HIGH**	**Exceedance of DWLOC**	**21-day average concentration (ug/L)- LOW**	**Exceedance of DWLOC**	**21-day average concentration (ug/L)- HIGH**	**Exceedance of DWLOC**
Oregon	0.294	21	392	28000	0.202	14	230	16429
Southern Oregon	0.745	53	698	49857	0.436	31	403	28786

Reference:

EPA Revised Drinking Water Assessment[7]

CPF use by schools

- According to the USGS in 2015 Wasco County had the highest use of chlorpyrifos in the state. This is cause for concern as Wasco County has almost 4,000 students who attend child care centers and schools in the county.[8]

Incident Data

- In 2014 the CDC reported occupational incidents through The National Environmental Public Health Tracking Network. There were 56 exposures to carbamates/ organophosphates and a 1.41 rate of pesticide exposure to carbamates/ organophosphates per 100,000 people in OR(https://ephtracking.cdc.gov/DataExplorer/index.html?c=PE&i=-1&m=-1).

Autism in OR

- In 2003, 7.2% of children ages 4-17 were ever diagnosed with ADHD, in OR, by 2012-2013 that percentage grew to 10.8%.[9]
- In Wasco County 14.8% of students ages 5-21 were enrolled in special education in 2015, of those students 7% had autism spectrum disorder.[10]
- In OR 11.5% of students ages 5-21 who were receiving special education in 2015 had autism spectrum disorder.[10]

Tables comparing EPA level of Concern with WA studies

Hypothetical DWLOC in children and women of reproductive age

(if there was no exposure to CPF from food residues etc.)

Study, Year	Population Subgroup	ssPoDwater* (µg/kg/day)	Hypothetical ssDWLOC** (µg/kg/day)	Water Exposure (µg/kg/day)	%ofssDWLOC
PSPP, 2012- 2015	Females (13-49 years old)	5.1	.051	.0097 Average Concentration	19
				.35 Maximum Concentration	686.3
	Young Children (1-2 years old)	3.2	.032	.0097 Average Concentration	30.3
				.35 Maximum Concentration	1,093.8
	Infants (<1 years old)	1.4	.014	.0097 Average Concentration	69.3
				.35 Maximum Concentration	2,500
NWQMC, 2016[5]	Females (13-49 years old)	5.1	.051	.066 Maximum Concentration	129.4
	Young Children (1-2 years old)	3.2	.032	.066 Maximum Concentration	206.3
	Infants (<1 years old)	1.4	.014	.066 Maximum Concentration	471.4

*steady state point of departure[11]

**steady state drinking water level of concern= PoD÷ UF (Total uncertainty factor= 100x)

Table with top selling produce Vs. EPA risk assessment

Oregon's Top Agricultural Crops of 2015, Treated with Chlropyrifos

Crop	Area Harvested (Acres)**	Value of Production (1,000 dollars)**	Chlorpyrifos Residue Detected***	Percent of U.S. Crop treated with Chlorpyrifos***
Berries*	20,500	169,436	Yes	35%
Pears	14,600	152,497	Yes	30%
Grapes	19,000	147,550	Yes	20%
Onions	18,500	125,273	No	50%
Hazelnuts	30,000	86,800	Yes	25%

*Berries= Blueberries, Blackberries, Black Raspberries, Red Raspberries, & Strawberries

References:

**Northwest Regional Office & USDA[12]

*** EPA 2014 Acute and Steady State dietary exposure analysis[13]

State Comments to attach:

Oregonians for Food & Shelter

OFS calls into question EPA's methods for determining an 'overly conservative unrefined drinking water assessment.' The OFS states that many of Oregon's crops fall into the 'minor crops' category which results in fewer pesticides labeled for use on them. CPF is among one of these pesticides. In 2010 there were 56 CPF- containing products registered for use on more than one hundred different crop/ sites in Oregon.

Oregon Strawberry Commission

The OSC expresses concern over two strawberry specific pests for which CPF is the only effective control method. The pests are strawberry crown moths and garden symphylans; these two pests are not mentioned in the EPA's Economic Analysis. The OSC states that they have and are funding research to find alternatives to CPF for strawberry specific pests, but have yet to find any effective alternatives.

Oregon Processed Vegetable Commission

The Oregon Processed Vegetable Commission expresses concern over cheap and effective alternative to CPF to mitigate for seed corn maggot, cabbage maggot and corn root worm and larvae. They acknowledge that there are alternatives but state that these alternatives have major shortcomings, they go on to mention that the alternatives, pyrethroids and neonicitinoids, have proven to be less effective because they lack the toxicity of CPF to a diverse array of pests.

Oregon Agricultural Chemicals & Fertilizers Association

The OACFA consists of dealers and manufactures of agricultural chemicals and fertilizers, as well as other agricultural specialists. The OACFA states that revoking CPF will have serious repercussions for Oregon's economy. According to the OACFA the Ag and Food industries account for 15% of Oregon's economy and provide 1 in every 10 jobs statewide. They state that the EPA has not completed the full review process and should first complete all health and safety evaluations before taking any actions.

Oregon Hazelnut Industry
The OHI states that their grower community (which stretches into WA) produces 99% of the U.S. hazelnut crop. They state that Lorsban is one of the most widely used and effective products utilized in hazelnut production and that it is the most cost-effective insecticide. The OHI mentions how 50% of the hazelnut crop grown in the U.S. is exported, they state that revoking the use of CPF could lead to potential border rejections and lost revenue in export markets.

References

1. USGS. USGS NAWQA: The Pesticide National Synthesis Project. https://water.usgs.gov/nawqa/pnsp/usage/maps/county-level/. Published 2017. Accessed March 20, 2017.

2. The United States Census Bureau. UNITED STATES QuickFacts from the US Census Bureau. https://www.census.gov/quickfacts/table/PST045216/00. Accessed March 20, 2017.

3. The United States Census Bureau. Yakima County, Washington. https://www.census.gov/quickfacts/table/RHI725215/53077. Accessed March 20, 2017.

4. Lambert WE, Lasarev M, Muniz J, et al. Variation in organophosphate pesticide metabolites in urine of children living in agricultural communities. *Environ Health Perspect*. 2005;113(4):504-508. doi:10.1289/ehp.6890.

5. National Water Quality Monitoring Council. Water Quality Data. https://www.waterqualitydata.us/portal/. Accessed March 17, 2017.

6. Oregon Department of Agriculture. Pesticide Stewardship Program. http://www.oregon.gov/ODA/programs/Pesticides/Water/Pages/PesticideStewardship.aspx. Accessed March 23, 2017.

7. U.S. Environmental Protection Agency. Chlorpyrifos: Refined Drinking Water Risk Assessment for Registration Review. 2016. https://www.regulations.gov/document?D=EPA-HQ-OPP-2015-0653-0437.

8. PublicSchoolReview.com. Wasco County, OR Public Schools. https://www.publicschoolreview.com/oregon/wasco-county. Accessed March 23, 2017.

9. Centers for Disease Control and Prevention. Prevalence | ADHD | NCBDDD | CDC. https://www.cdc.gov/ncbddd/adhd/prevalence.html. Published 2017. Accessed March 22, 2017.

10. Oregon Department of Education. 2015-2016 IDEA Federal Reports : Special Education Reports and Data : State of Oregon. http://www.oregon.gov/ode/reports-and-data/SpEdReports/Pages/2015-2016-IDEA-Federal-Reports.aspx. Accessed March 23, 2017.

11. U.S. Environmental Protection Agency. Chlorpyrifos: Revised Human Health Risk Assessment for Registration Review. 2016. https://www.regulations.gov/document?D=EPA-HQ-OPP-2015-0653-

0454.

12. USDA, Northwest Regional Office. *2016 Oregon Annual Statistical Bulletin*.; 2016. https://www.nass.usda.gov/Statistics_by_State/Oregon/Publications/Annual_Statistical_Bulletin/2016/bulletin_or_2016.pdf. Accessed March 23, 2017.

13. U.S. Environmental Protection Agency. Chlorpyrifos: Acute and Steady State Dietary (Food Only) Exposure Analysis to Support Registration Review. https://www.regulations.gov/document?D=EPA-HQ-OPP-2008-0850-0197.

New York CPF Data

<u>Bulleted Talking points</u>

- In 2015 an estimated 100,028pounds of Chlorpyrifos were used on New York fields, according to the USGS. [1]
- Children, below the age of 5, and pregnant women are most susceptible to the adverse effects of CPF. According to the latest United States census there are 1,155,822 children under 5 years of age and 4,797,187 women of childbearing age in New York State.[2]
- In 2015 Wayne County was 90% non- Hispanic white and 12.2% of the population lived in poverty.[3]
- According to the USGS, in 2015, Wayne County had the highest use of chlorpyrifos in the state. This is cause for concern as there are over 17,031 public school students (K-12) who attend 39 school facilities in the county.[4]
- From 2012-2014 Wayne county had an unemployment rate of 5.4% (which is similar to the NYS average of 5.3%).[5]

<u>Water Monitoring</u>

- According to the National Water Quality Monitoring Data there were two statewide detections of Chlopyrifos in 2016 the minimum concentration was 161ng/L and the maximum concentration was 504ng/L. [6]

Estimated Drinking Water Concentrations of Chlorpyrifos Resulting from the Use of Chlorpyrifos on a Regional Basis

	1-in-10 year							
State	**24 hr average concentration (ug/L)- LOW**	**Exceedance of DWLOC**	**24 hr average concentration (ug/L)- HIGH**	**Exceedance of DWLOC**	**21-day average concentration (ug/L)- LOW**	**Exceedance of DWLOC**	**21-day average concentration (ug/L)- HIGH**	**Exceedance of DWLOC**
NY	0.859	61	858	61286	0.545	39	426	30429
NW NY	0.837	60	669	47786	0.579	41	406	29000

Reference:

EPA Revised Drinking Water Assessment[7]

Agricultural Use

- According to the New York Farm Bureau, onions are the most important vegetable crop, in terms of crop value in NYS. 95% of the onions produced in New York State have been treated with chlorpyrifos (comments: New York Farm Bureau).
- According to the New York Farm Bureau, New York is the number one producer of fresh cabbage in the country, without effective alternatives the loss of chlorpyrifos would have significant impacts on production and profitability (comments: New York Farm Bureau).
- According to the Cornell Cooperative Extension – Lake Ontario Fruit Program, the current use of chlorpyrifos, on apples, is limited to prebloom application for the control of San Jose scale. In the EPA's Analysis of the Small Business Impact of Revoking Chlorpyrifos Food Tolerances five possible alternatives are provided. One alternative would be to substitute the use of chlorpyrifos with petroleum oil and pyriproxyfen, to control for San Jose scale, this would cost the average farmer $46 more per acre (comments: The Cornell Cooperative Extension).[8]

Incident Data

- In 2014 the CDC reported occupational incidents through The National Environmental Public Health Tracking Network. There were 162 exposures to carbamates/ organophosphates and a .82 rate of pesticide exposure to carbamates/ organophosphates per 100,000 people (https://ephtracking.cdc.gov/DataExplorer/index.html?c=PE&i=-1&m=-1).

Autism in NYS

- In 2000, 6,752 or 1.53% of children ages 3-21 who received special education services in NY had autism, by 2012-2013 that number grew to 26,964 or 5.98%.[9]

Table comparing EPA level of Concern with NY studies

Hypothetical DWLOC in children and women of reproductive age

(if there was no exposure to CPF from food residues etc.)

Study, Year	Population Subgroup(can Include children and youths)	ssPoDwater* (µg/kg/day)	Hypothetical ssDWLOC** (µg/kg/day)	Water Exposure (µg/kg/day)	%ofssDWLOC
NWQMC, 2016[6]	Females (13-49 years old)	5.1	.051	.33Average Concentration	647
	Young Children (1-2 years old)	3.2	.032	.33Average Concentration	1,031.3
	Infants (<1 years old)	1.4	.014	.33Average Concentration	2,357.1
USGS, 2015[10]	Females (13-49 years old)	5.1	.051	<.0100Average Concentration	19.6
	Young Children (1-2 years old)	3.2	.032	<.0100Average Concentration	31.3
	Infants (<1 years old)	1.4	.014	<.0100Average Concentration	71.4

*steady state point of departure[11]

**steady state drinking water level of concern= PoD÷ UF (Total uncertainty factor= 100x)

Table with top selling produce Vs. EPA risk assessment

New York State's Top Agricultural Crops of 2015, Treated with Chlropyrifos

Crop	Area Harvested (Acres)*	Value of Production (1,000 dollars)*	Chlorpyrifos Residue Detected**	Percent of U.S. Crop treated with Chlorpyrifos**
Apples	40,000	274,545	Yes	55%
Grapes	37,000	56,599	Yes	10%
Onions	7,500	40,533	No	40%
Peaches	1,600	8,631	Yes	25%
Strawberries	800	7,366	Yes	20%

References:

* New York State Department of Agriculture & USDA[12]

**EPA 2014 Acute and Steady State dietary exposure analysis[13]

State Comments to attach:

Cornell Cooperative Extension

New York Farm Bureau

The New York State Agribusiness Association

The NYSABA argues that the continued use of chlorpyrifos is necessary in order to properly implement IPM and that a ban may lead to increased use of other harmful pesticides.

References

1. USGS. USGS NAWQA: The Pesticide National Synthesis Project. https://water.usgs.gov/nawqa/pnsp/usage/maps/county-level/. Published 2017. Accessed March 20, 2017.

2. The United States Census Bureau. UNITED STATES QuickFacts from the US Census Bureau. https://www.census.gov/quickfacts/table/PST045216/00. Accessed March 20, 2017.

3. United States Census Bureau. Wayne County, New York. https://www.census.gov/quickfacts/table/DIS010215/36117. Accessed March 20, 2017.

4. New York Schools. Wayne County New York School Districts. http://www.newyorkschools.com/counties/wayne.html. Published 2017. Accessed March 20, 2017.

5. New York State Department of Health. Socio-Economic Status and General Health Indicators - Wayne County. https://www.health.ny.gov/statistics/chac/chai/docs/ses_54.htm. Published 2016. Accessed March 22, 2017.

6. National Water Quality Monitoring Council. Water Quality Data. https://www.waterqualitydata.us/portal/. Accessed March 17, 2017.

7. U.S. Environmental Protection Agency. Chlorpyrifos: Refined Drinking Water Risk Assessment for Registration Review. 2016. https://www.regulations.gov/document?D=EPA-HQ-OPP-2015-0653-0437.

8. U.S. Environmental Protection Agency. *Analysis of the Small Business Impacts of Revoking Chlorpyrifos Food Tolerances*.; 2015. https://www.regulations.gov/document?D=EPA-HQ-OPP-2015-0653-0437.

9. Easter Seals I. 2012 State Autism Profiles: New York. http://www.easterseals.com/shared-components/document-library/2012_autism_newyork.pdf. Published 2012. Accessed March 22, 2017.

10. Scott T-M, Nystrom E, Reddy J. *Groundwater Quality in the Chemung River, Eastern Lake Ontario, and Lower Hudson River Basins, New York, 2013*.; 2015.

https://pubs.usgs.gov/of/2015/1168/ofr20151168.pdf. Accessed March 17, 2017.

11. U.S. Environmental Protection Agency. Chlorpyrifos: Revised Human Health Risk Assessment for Registration Review. 2016. https://www.regulations.gov/document?D=EPA-HQ-OPP-2015-0653-0454.

12. USDA, New York Agricultural Statistics. *2015-2016 Agricultural Statistics Annual Bulletin: New York*.; 2016. https://www.nass.usda.gov/Statistics_by_State/New_York/Publications/Annual_Statistical_Bulletin/2016/2015-2016 NY Annual Bulletin.pdf. Accessed March 20, 2017.

13. U.S. Environmental Protection Agency. Chlorpyrifos: Acute and Steady State Dietary (Food Only) Exposure Analysis to Support Registration Review. https://www.regulations.gov/document?D=EPA-HQ-OPP-2008-0850-0197.

Maryland CPF Data

Bulleted Talking points

- In 2015 an estimated 18,452 pounds of chlorpyrifos were used on Maryland fields, according to the USGS.[1]
- Children, below the age of 5, and pregnant women are most susceptible to the adverse effects of CPF. According to the latest United States census there are 364,488 children under 5 years of age and 1,433,018 women of childbearing age in Maryland.[2]
- In 2015 Washington County was 80.4% non-Hispanic white and 12% of the population lived in poverty.[3]
- In 2015 Washington County had a 5.8% unemployment rate, which was about the average for the entire state.[4]

CPF use by schools

- According to the USGS in 2015 Washington County had the highest use of chlorpyrifos in the state. This is cause for concern as there are over 22,000 public school students (1-12) who attend 46 school facilities in the county.[5]
- Maryland citizens are concerned about the impact of pesticides on the environment and general health. This is evidenced by Montgomery County being the first major locality in the nation to restrict the use of neonicotinoids, through the Maryland Pollinator Act of 2016.

Incident Data

- In 2014 the CDC reported occupational incidents through The National Environmental Public Health Tracking Network. There were 71 exposures to carbamates/ organophosphates and a

1.19 rate of pesticide exposure to carbamates/ organophosphates per 100,000 people (https://ephtracking.cdc.gov/DataExplorer/index.html?c=PE&i=-1&m=-1).

Autism in MD

- Autism and Development delay incidents have been on the rise in MD since 2000. In 2000 1,943 (1.8%) were categorized as having a developmental delay, by 2010 the category grew to 6,901 (7.7%). Between 2000- 2010 the statewide rates of students with autism have quadrupled from around 2% (2,304 students) to almost 9% (8,828 students) in 2010.[6]

Estimated Drinking Water Concentrations of Chlorpyrifos Resulting from the Use of Chlorpyrifos on a Regional Basis

	1-in-10 year							
State	**24 hr average concentration (ug/L)- LOW**	**Exceedance of DWLOC**	**24 hr average concentration (ug/L)- HIGH**	**Exceedance of DWLOC**	**21-day average concentration (ug/L)- LOW**	**Exceedance of DWLOC**	**21-day average concentration (ug/L)- HIGH**	**Exceedance of DWLOC**
MD	0.859	61	858	61286	0.545	39	426	30429

References:

EPA Revised Drinking Water Assessment[7]

Table with top selling produce, Vs. EPA risk assessment

Maryland's Top Agricultural Crops of 2015, Treated with Chlropyrifos

Crop	Area Harvested (Acres)*	Value of Production (1,000 dollars)*	Chlorpyrifos Residue Detected**	Percent of U.S. Crop treated with Chlorpyrifos**
Watermelons	3,200	13,520	Yes	2.5%
Apples	1,800	8,255	Yes	55%
Sweet Corn	3,600	6,048	No	2.5%
Cantaloupes	500	1,680	Yes	2.5%

References:

* Maryland Department of Agriculture & USDA[8]

**EPA 2014 Acute and Steady State dietary exposure analysis[9]

References

1. USGS. USGS NAWQA: The Pesticide National Synthesis Project. https://water.usgs.gov/nawqa/pnsp/usage/maps/county-level/. Published 2017. Accessed March 20, 2017.

2. The United States Census Bureau. UNITED STATES QuickFacts from the US Census Bureau. https://www.census.gov/quickfacts/table/PST045216/00. Accessed March 20, 2017.

3. United States Census Bureau. Washington County, Maryland. https://www.census.gov/quickfacts/table/INC110215/24043. Accessed March 20, 2017.

4. Department of Labor L& R. Annual Local Area Unemployment Statistics - Office of Workforce Information and Performance. https://www.dllr.state.md.us/lmi/laus/lausann.shtml. Accessed March 22, 2017.

5. Schools | Washington County Public Schools. http://wcpsmd.com/schools. Published 2015. Accessed March 20, 2017.

6. Maryland Commission on Autism. *Addressing the Needs of Individuals with Autism Spectrum Disorders in Maryland*.; 2012. http://dhmh.maryland.gov/autism/Documents/FINAL_AUTISM_REPORT_10-5-2012.pdf. Accessed March 22, 2017.

7. U.S. Environmental Protection Agency. Chlorpyrifos: Refined Drinking Water Risk Assessment for Registration Review. 2016. https://www.regulations.gov/document?D=EPA-HQ-OPP-2015-0653-0437.

8. Maryland Department of Agriculture, USDA. *Agriculture in Maryland*.; 2015. https://www.nass.usda.gov/Statistics_by_State/Maryland/Publications/Annual_Statistical_Bulletin/2015/2015-2016 MD Annual Bulletin.pdf. Accessed March 20, 2017.

9. U.S. Environmental Protection Agency. Chlorpyrifos: Acute and Steady State Dietary (Food Only) Exposure Analysis to Support Registration Review. https://www.regulations.gov/document?D=EPA-HQ-OPP-2008-0850-0197.

Appendix G

Draft of Apple Fact Sheet

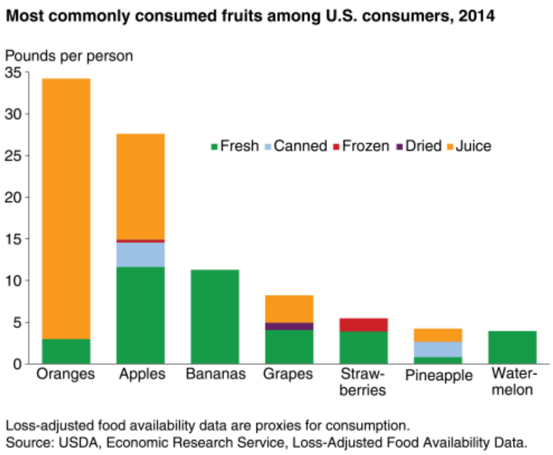
NRDC Fact Sheet

Why Organic Apples?

Apples are one of the mostly commonly consumed products in the U.S., accounting for most of children's dietary intake of fruits. A trend towards organic produce has begun among the American consumer and is continuing to grow; this is due in large part to growing public awareness of harmful chemical residues found on produce. Some of these residues such as the organophosphate chlorpyrifos have been linked to permanent brain developmental damage in children.

Apple Consumption in the U.S.

Apples are the second most commonly consumed fruits in the United States[1].



1

Americans consumed an average of 119.9 pounds of fresh and processed fruits per person in 2014, apples accounted for 11.6 pounds of fresh fruits consumed[1]. Children under the age of 6 and adults over the age of 65 consume the most fruits and vegetables[2].

Males and females from the age of 2-19 consume an average of 1.13 cups of fruit per day, while children from the age of 2-5 consume an average of 1.41 cups[3].Apples account for 18.9% of the total fruit intake of children ages 2-19[4].

Fruit has become a major snacking commodity and accompanies many American meals. Over the past 5 years children of all ages have increased their consumption of fresh fruit berries, bananas, apples and oranges are driving this increase[2].

The age old saying goes an apple a day keeps the doctor away. Parents feed their children fruits and vegetables to keep them healthy. Yet, a threat lurks on the surface of these nutritious foods, this is the threat of pesticide residues, specifically organophosphates, like chlorpyrifos, which remain on our produce even when consumed.

Pesticide Residue on Apples

In 2015 84% of apple acreage in the U.S. was treated with some form of chemical[5]. 55% of apple acreage was treated with the harmful insecticide chlorpyrifos. The table illustrates chlorpyrifos residues and use patterns on select fruits.

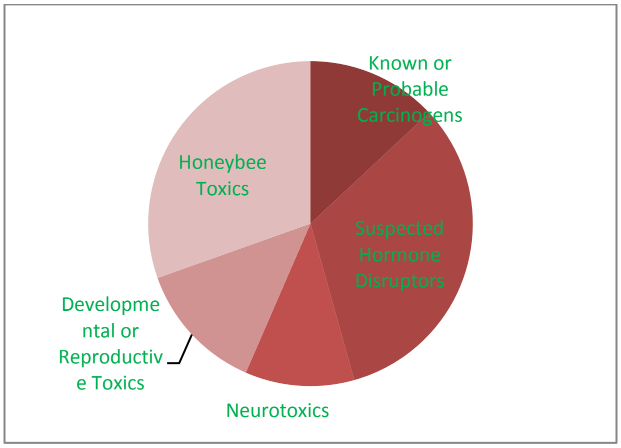
Children's favorite fruits contaminated by chlorpyrifos

Fruit	Percent of whole fruit (not juice) in kinds' diets*	Chlorpyrifos residue detected**	Percent of US crop treated with chlorpyrifos**
Apples	36%	Yes	55%
Peaches/ Nectarines	7%	Yes	25%/10%
Citrus	9%	Yes	Oranges- 20%
Berries	8%	Yes	Strawberries- 20%
Grapes	5%	Yes	10%

Table shows fruits commonly consumed by children, detection of chlorpyrifos residues by the U.S. Department of Agriculture Pesticide Data Program testing, and the percent of the U.S. crop treated with chlorpyrifos [46].

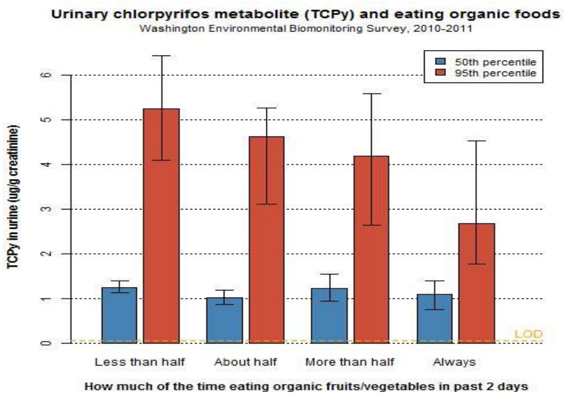
In 2015 the USDA Pesticide Data Program found 48 pesticide residues on apples. These include harmful organophosphates, hormone disruptors, neuro toxics, carcinogens, developmental or reproductive toxics and honeybee toxics[5].

Human and Environmental Health Effects of Pesticide Residues Found on Apples



[5]

A study conducted in 2008 found that 91% of children tested had evidence of organophosphate pesticide exposure in their bodies[7]. Residue on foods is one of the main modes by which we are exposed to chlorpyrifos. Concentrations of chlorpyrifos are especially high in children with conventional diets, in families where children switched to eating organic produce exposure fell significantly[7]. The Washington State Department of Public Health found that individuals who always eat organic have considerably lower levels of chlopyrifos in their bodies then individuals who eat organic less than half the time[8]. When compared to conventional, organic produce has substantially higher amounts of antioxidants and the frequency of pesticide residue found on organic produce is 4 times lower[9].



Group	n	50th percentile	95th percentile
Less than half the time	356	1.24 (1.14-1.39)	5.25 (4.09-6.44)
About half the time	155	1.03 (0.876-1.19)	4.62 (3.12-5.27)
More than half the time	80	1.22 (0.944-1.55)	4.2 (2.65-5.6)
Always	42	1.09 (0.758-1.39)	2.68 (1.78-4.54)

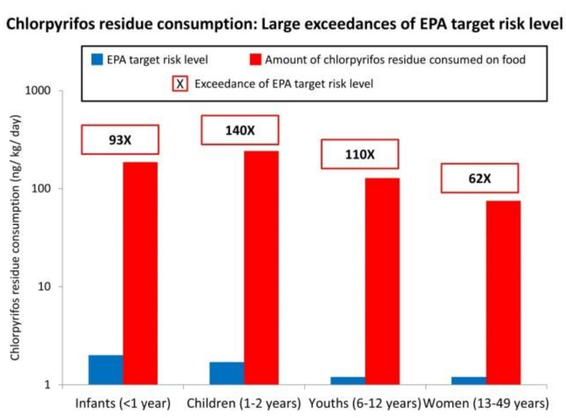
8

The American consumer has become increasingly aware of the foods they eat and those they feed their children. Teen consumption of organic foods has been on a steady rise from 33% of teens in 2011 reporting consumption of organic foods to 41% in 2014[10]. In 2016 the USDA noted that 7% of the total U.S. apple acreage is run by organic farming systems. Although the retail price of organic apples is higher the American consumer has made the choice to switch over to purchasing organic apples. This consumer demand, for organic apples, has led to huge growths within the organic apple sector[11].

Description of EPA's dietary findings

In November 2016, EPA released an updated chlorpyrifos safety assessment which addresses low-level exposures shown in multiple studies to disrupt brain development leading to developmental delays, lower IQ, autism and ADHD[12–14].

The EPA found that chlorpyrifos residues on food, including fruits and vegetables, are unsafe for pregnant women and children[15]. As shown in the graph, EPA's analysis found that residue exposures were far above their target risk level—in some cases, by up to 140 times! According to EPA's analysis, a ban of chlorpyrifos use on food is needed to make the food supply safe for pregnant women and kids.



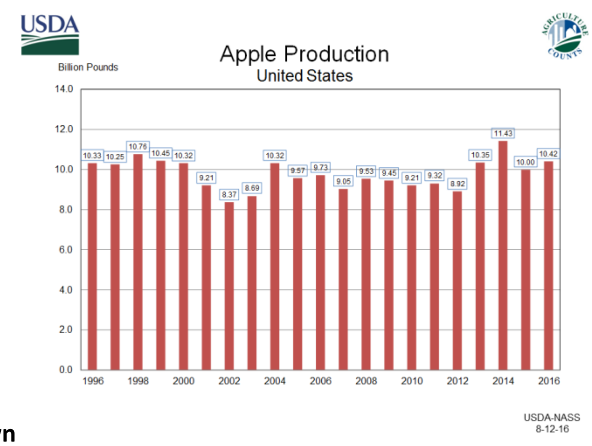
Graph shows the EPA target risk level for chlorpyrifos residue consumption, compared to amounts of chlorpyrifos residue consumed on food, in nanograms per kilogram of body weight per day for infants, children and women[6]

Some of children's favorite fruits have widespread contamination with chlorpyrifos residues. The table illustrates chlorpyrifos residues and use patterns on select fruits.

Children's favorite fruits contaminated by chlorpyrifos

Fruit	Percent of whole fruit (not juice) in kids' diets*	Chlorpyrifos residue detected**	Percent of US crop treated with chlorpyrifos**
Apples	36%	Yes	55%
Peaches/ Nectarines	7%	Yes	25%/10%
Citrus	9%	Yes	Oranges- 20%
Berries	8%	Yes	Strawberries- 20%
Grapes	5%	Yes	10%
Melons	11%	Yes	<2.5%

Table shows fruits commonly consumed by children, detection of chlorpyrifos residues by the U.S. Department of Agriculture Pesticide Data Program testing, and the percent of the U.S. crop treated with chlorpyrifos[4,6].



[20]

Where Apples Are Grown

There are over 7,500 varieties of apples grown worldwide, the U.S. grows about 2,500 varieties of apples[16]. In 2016 over 10 billion pounds of apples were produced nationally. Washington State accounted for 61% of the apples produced in the U.S. Apples are grown in every state, the other leading apple producing states are New York, Michigan, Pennsylvania, and California[17].

1. U.S. Department of Agriculture. USDA ERS - Food Availability and Consumption. https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/food-availability-and-consumption/. Accessed March 3, 2017.

2. Produce for Better Health Foundation. State of the Plate: 2015 Study on America’s Consumption of Fruit & Vegetables. http://www.pbhfoundation.org/pdfs/about/res/pbh_res/State_of_the_Plate_2015_WEB_Bookmarked.pdf. Accessed March 3, 2017.

3. U.S. Department of Agriculture. FPED data tables : USDA ARS. https://www.ars.usda.gov/northeast-area/beltsville-md/beltsville-human-nutrition-research-center/food-surveys-research-group/docs/fped-data-tables/. Accessed March 3, 2017.

4. Herrick K a., Rossen LM, Nielsen SJ, Branum a. M, Ogden CL. Fruit Consumption by Youth in the United States. *Pediatrics*. 2015;136(4):664-671. doi:10.1542/peds.2015-1709.

5. U.S. Department of Agriculture. PDP Databases and Annual Summaries | Agricultural Marketing Service. https://www.ams.usda.gov/datasets/pdp/pdpdata. Accessed March 3, 2017.

6. U.S. Environmental Protection Agency. Chlorpyrifos: Acute and Steady State Dietary (Food Only) Exposure Analysis to Support Registration Review. https://www.regulations.gov/document?D=EPA-HQ-OPP-2008-0850-0197.

7. Lu C, Barr DB, Pearson M a, Waller L a. Dietary Intake and Its Contribution to Longitudinal Organophosphorus Pesticide Exposure in Urban / Suburban Children. *Environ Health Perspect*. 2008;116(4):537-542. doi:10.1289/ehp.10912.

8. Washington State Department of Public Health. Chlorpyrifos Pesticide (TCPy) Creatinine-Corrected. http://www.doh.wa.gov/DataandStatisticalReports/EnvironmentalHealth/WashingtonTrackingNetworkWTN/Biomonitoring/90. Accessed March 3, 2017.

9. Barański M, Średnicka-Tober D, Volakakis N, et al. Higher antioxidant and lower cadmium concentrations and lower incidence of pesticide residues in organically grown crops: a systematic literature review and meta-analyses. *Br J Nutr*. 2014;112(5):794-811. doi:10.1017/S0007114514001366.

10. Wissink S, Tamminga N, Murphy E, et al. Taking Stock With Teens. http://www.kidsenjongeren.nl/wp-content/uploads/2014/10/Taking-Stock-Teach-In-Fall-2014.pdf. Accessed March 3, 2017.

11. Agricultural Marketing Resource Center. Organic Apples. http://www.agmrc.org/commodities-products/fruits/apples/organic-apples/. Accessed March 3, 2017.

12. Rauh VA, Garfinkel R, Perera FP, et al. Impact of prenatal chlorpyrifos exposure on neurodevelopment in the first 3 years of life among inner-city children. *Pediatrics*. 2006;118(6):e1845-59. doi:10.1542/peds.2006-0338.

13. Bouchard MF, Chevrier J, Harley KG, et al. Prenatal Exposure to Organophosphate Pesticides and IQ in 7-Year Old Children. *Environ Health Perspect*. 2011;1003185(April). doi:10.1289/ehp.1003185.

14. Whyatt RM, Camann D, Perera FP, et al. Biomarkers in assessing residential insecticide exposures during pregnancy and effects on fetal growth. In: *Toxicology and Applied Pharmacology*. Vol 206. ; 2005:246-254. doi:10.1016/j.taap.2004.11.027.

15. U.S. Environmental Protection Agency. Chlorpyrifos: Revised Human Health Risk Assessment for Registration Review. 2016. https://www.regulations.gov/document?D=EPA-HQ-OPP-2015-0653-0454.

16. Geisler M. Commodity Apples | Agricultural Marketing Resource Center. http://www.agmrc.org/commodities-products/fruits/apples/commodity-apples/. Accessed March 3, 2017.

17. U.S. Department of Agriculture. USDA/NASS QuickStats Ad-hoc Query Tool. https://quickstats.nass.usda.gov/#A7BAD1E7-E7C4-3657-B1BA-3182B1B4F0E2. Accessed March 3, 2017.

Appendix H

Table Compiling the Pesticide Residues Found on Apples by the USDA in 2015

Pesticide	Use	Number of Samples	Samples with Detections	% of Samples with Detection	Range of Values Detected, PPM	EPA Tolerance Level, ppm
Acetamiprid	Insecticide	708	196	27.70%	.002-.38	1
Bifenthrin	Insecticide	708	1	0.10%	.013^	0.5
Boscalid	Fungicide	708	179	25.30%	.003-.18	3
Buprofezin	Insecticide	708	10	1.40%	.002-.020	3
Carbaryl	Insecticide	708	9	1.30%	.003-1.00	12
Carbendazim-MBC	Fungicide	708	131	18.50%	.001-.13	2
Chlorpaniliprole	Insecticide	708	134	18.90%	.010-.088	1.2
Chlorpyrifos	Insecticide	708	3	0.40%	.005-.008	0.1
Cyfluthrin	Insecticide	708	13	1.80%	.005-.032	0.5
Cyhalothrin	Insecticide	708	29	4.10%	.005-.067	0.3
Cypemethrin	Insecticide	708	4	0.60%	.012-.026	2
Cyprodinil	Fungicide	708	28	4%	.005-.058	1.7
Diazion	Insecticide	708	26	3.70%	.006-.21	0.5
Difenoconazole	Fungicide	708	5	0.70%	.010-.017	5
Diphenylamine		708	582	82.20%	.002-4.1	10
Dodine	Fungicide	708	4	0.60%	.029-.23	5
Endosulfan I	Insecticide	708	4	0.60%	.010-.015	1
Endosulfan II	Insecticide	708	7	1%	.016-.051	1
Endosulfan Sulfate	Insecticide	708	8	1.10%	.007-.018	1
Esfenvalerate & Fenvalerate	Insecticide	708	1	0.10%	.016^	1
Fenbuconazole	Fungicide	708	4	0.60%	.020-.028	0.4
Fenpropathrin	Insecticide	708	11	1.60%	.021-.25	5
Fenpyroximate	Acaricide	708	27	3.80%	.005-.024	0.3

Flonicamid	Insecticide	708	7	1%	.010-.018	0.2
Flubendiamide	Insecticide	708	22	3.10%	.004-.079	1.5
Fludioxonil	Fungicide	708	251	35.50%	.026-2.8	5
Fluopyram	Fungicide	295	4	1.40%	.006-.042	0.8
Hexythiazox	Insecticide, Acaricide	708	36	5.10%	.002-.058	0.4
Imidacloprid	Insecticide	708	96	13.60%	.003-.033	0.5
Indoxacarb	Insecticide	708	1	0.10%	.028^	1
Methoxyfenozide	Insecticide	708	22	3.10%	.003-.093	2
Myclobutanil	Fungicide	708	10	1.40%	.003-.019	0.5
o-Phenylphenol	Fungicide	708	10	1.40%	.008-.076	25
Phosmet	Insecticide	708	41	5.80%	.011-.43	10
Pyraclostrobin	Fungicide	708	133	18.80%	.003-.099	1.5
Pyridaben	Insecticide, Acaricide	472	3	0.60%	.008-.062	0.5
Pyrimethanil	Fungicide	708	173	24.40%	0.050-7.8	15
Pyriproxyfen	Insecticide, growth regulator	708	13	1.80%	.001-.014	0.2
Spinetoram	Insecticide	708	12	1.70%	.004-.007	0.2
Spinosad A	isomer of Spinosad	708	1	0.10%	.003^	0.2
Spirodiclofen	Acaricide	708	137	19.40%	.010-.22	0.8
Spirotetramat	Insecticide	708	1	0.10%	.003^	0.7
Tebufenozide	Insecticide	708	3	0.40%	.008-.025	1
Tetrahydrophthalimide - THPI	metabolite of Captafol and Captan	708	102	14.40%	.010-1.5	25
Thiabendazole	Fungicide	708	479	67.70%	.002-3.5	5
Thiacloprid	Insecticide	708	86	12.10%	.001-.029	0.3

Thiamethoxam	Insecticide	708	7	1.00%	.004-.018	0.2
Trifloxystrobin	Fungicide	708	40	5.60%	.002-.028	0.5

https://www.ams.usda.gov/sites/default/files/media/
2015PDPAnnualSummary.pdf

Appendix I

Learning Contract for the Fieldwork Project

Goal 1: Support health protective policies for the pesticide Chlorpyrifos				
Objectives	Activities	Start/ End Date	Who is Responsible	Tracking Measures
Educate policy makers, in D.C., about the risks associate with Ag use of Chlorpyrifos	Research the risk associated with Chlorpyrifos use Create a general fact sheet for policy makers	January 30th 2017- February 24th 2017	Lucia	Multiple drafts for review Finished product
Educate policy makers, on individual state levels, about the risk associated with Ag use of Chlorpyrifos	Research state specific impacts of Chlorpyrifos use Contact individuals and agencies on the state level who have information about the impacts of Chlorpyrifos use Create state specific factsheets for policy makers	February 5th, 2017- March 31st, 2017	Lucia	Regular Check-ins Multiple drafts Finished products
Compile a summary of alternatives for future use Into a Spreadsheet	Draw from the EPA's Economic impact analysis Conduct research on alternatives	March 1st, 2017- March 31st, 2017	Lucia	Multiple drafts for review Finished spread sheet
Connect with retailers Provide fact sheets on ingredient specific products that the retailer uses	Conduct research on ingredient specific exposures to Chlorpyrifos Create an factsheet on apples	February 24th, 2017- March 31st, 2017	Lucia	Check-ins Finished fact sheet
Illustrate who bears the burden of continued Chlorpyrifos use	Conduct outreach and compile stories of people and families harmed by Chlorpyrifos	February 5th 2017- March 31st 2017	Miriam Lucia	Spread sheet Finished stories

Appendix J

Core Competencies for the Fieldwork Project

USF MPH Competencies	Notes
Evidence-based Approaches to Public Health	
Interpret results of data analysis for public health research, policy or practice	This project included researching the impacts of chlorpyrifos on child health, prenatal health and on agricultural communities. The research was analyzed to determine the persistence of chlorpyrifos in human bodies, air and water, to indicate human exposure. Lastly, the information was synthesized into factsheets and spreadsheets, in support of policy reform.
Policy in Public Health	
Discuss multiple dimensions of the policy-making process, including the roles of ethics and evidence	The main component of this project was to communicate the harmful effects of chlorpyrifos to policy makers, retailers, the general public and outside agencies. The project called for policy makers to support health protective policies for chlorpyrifos by illustrating how harmful it is to children and pregnant women.
Propose strategies to identify stakeholders and build coalitions and partnerships for influencing public health outcomes	A major component of this project was to collaborate with fellow state organizations on chlorpyrifos use reform. This included working with environmental organizations to create relevant materials, talking points and greater public awareness of the issue. The NRDC acts as a liaison between advocacy groups and policy groups.
Evaluate policies for their impact on public health and health equity	This project included compiling a list of risks associated with chlorpyrifos exposure and determining how individuals exposed to chlorpyrifos are treated and what their health outcomes are. The project explored alternative options to chlorpyrifos use and pushed for change on federal and state policies to regulate pesticide use.
Leadership	
Select communication strategies for different audiences and sectors	The project involved communicating the science behind chlorpyrifos to the general public, policy makers, lawyers and retailers. After compiling data on the harmful effects of

	chlorpyrifos this information was disseminated in appropriate modes to reach policy makers, retailers and other environmental agencies.
Communicate audience-appropriate public health content, both in writing and through oral presentation	The main component of this project was to help push for new legislation, this was done by creating fact sheets, some of these fact sheets are specifically for policymakers while others are for retailers that utilize produce heavily contaminated with chlorpyrifos. The project also included creating spreadsheets with chlorpyrifos information for the internal use of NRDC lawyers.
Systems Thinking	
Apply systems thinking tools to a public health issue	The project focused on navigating how public health science and policy intersect and identifying how to advance public health initiatives. This was accomplished by researching the health effects of chlorpyrifos and communicating this science to policy makers. The project assed how to reach policy makers and what goes into passing new health protective policies.

Appendix K

MPH Program Fieldwork Time Log

UNIVERSITY OF SAN FRANCISCO | School of Nursing and Health Professions

Master of Public Health Program
FIELDWORK TIME LOG

Student Information	
Student's Name: Lucia Ruiz	Campus ID # 20376914
Student's Phone: (415) 867-0038	Student's Email: lmruiz2@dons.usfca.edu
Preceptor Information	
Preceptor's Name: Veena Singla & Miriam Rotkin-Ellman	Preceptor's Title: Staff Scientist & Senior Staff Scientist
Preceptor's Phone: (415) 875-6126 (415) 875-6100	Preceptor's Email: vsingla@nrdc.org mrotkinellman@nrdc.org
Organization: Natural Resource Defense Council	
Student's Start Date: January 30th, 2017	Student's End Date: Hours/week: March 31st, 2017

Time Log for (Check One):

____X________ **Spring 2017** __________________**Fall 2016**

Week	Total # of Hours for Week	Preceptor Initials
01/30/17 - 02/03/17	33	VS
2/06/17 - 2/10/17	35	VS
2/13/17 - 2/17/17	34	VS
2/20/17 - 2/24/17	28	VS
2/27/17 - 3/3/17	34	VS
3/6/17 - 3/10/17	35	VS
3/13/17 - 3/17/17	35	VS
3/20/17 - 3/24/17	35	VS
3/27/17 - 3/31/17	35	VS

Appendix L

MPH Program Student Evaluation of Field Experience

UNIVERSITY OF SAN FRANCISCO | School of Nursing and Health Professions

Master of Public Health Program
Student Evaluation of Field Experience

Student Information	
Student's Name: Lucia Ruiz	Campus ID # 20376914
Student's Phone: (415) 867-0038	Student's Email:
Preceptor Information	
Preceptor's Name: Veena Singla & Miriam Rotkin-Ellman	Preceptor's Title: Staff Scientist & Senior Staff Scientist
Preceptor's Phone: (415) 875-6126 (415) 875-6100	Preceptor's Email:vsingla@nrdc.org mrotkinellman@nrdc.org
Organization: The Natural Resource Defense Council	
Student's Start Date: January 30th, 2017	Student's End Date: Hours/week: March 31st, 2017

Please use the following key to respond to the statements listed below.

SA = Strongly Agree A = Agree D = Disagree SD = Strongly Disagree N/A = Not Applicable

My Field Experience...					
Contributed to the development of my specific career interests	**SA**	A	D	SD	N/A
Provided me with the opportunity to carry out my field learning objective activities	**SA**	A	D	SD	N/A
Provided the opportunity to use skills obtained in MPH classes	**SA**	A	D	SD	N/A
Required skills I did not have Please list: Further understanding of toxicology	SA	**A**	D	SD	N/A
Required skills I have but did not gain in the MPH program Please list: Introduction to Toxicology	SA	**A**	D	SD	N/A
Added new information and/or skills to my graduate education Please list: Introduction to Toxicology Risk assessment interpretations Translating scientific information for the general public Environmental policy Integrated Pest Management Techniques Coalition building and maintenance techniques	**SA**	A	D	SD	N/A
Challenged me to work at my highest level	SA	**A**	D	SD	N/A
Served as a valuable learning experience in public health practice	**SA**	A	D	SD	N/A
I would recommend this agency to others for future field experiences.	**Yes**			NO	
My preceptor...					
Was valuable in enabling me to achieve my field learning objectives	**SA**	A	D	SD	N/A
Was accessible to me	SA	**A**	D	SD	N/A

Initiated communication relevant to my special assignment that he/she considered of interest to me	SA	A	D	SD	N/A
Initiated communication with me relevant to general functions of the agency	SA	A	D	SD	N/A

2. Would you recommend this preceptor for future field experiences? Please explain.

____Yes ______No ______Unsure

I would recommend this preceptor for future field experiences. Veena was extremely welcoming and connected me with individuals in my interested field. She helped me set up informational interviews with multiple individuals inside and outside of the agency, as well as provided me with the opportunity to attend conferences surrounding pesticide use and farmworker health.

3. Please provide additional comments explaining any of your responses.

Due to a lag in time receiving new products I feel that this internship did not challenge me to work at my highest level. When I received my assignments I would get them done as quickly as possible and often supplemented my work with outside research. But the lag time in meeting with my preceptors and getting new assignments left a bit of time where I was unsure as to what I could work on next. This is something moving forward I would like to work on. I would like to develop problem solving techniques and start thinking outside the box, so I can think logically what assignments would be most helpful for a given project.

I interned with Scientists in the Health Program, which meant there was a fair amount of toxicology and data interpretation involved. I felt that my education did not provide the knowledge I needed for this internship, as such I spent some time, outside of my internship hours, researching toxicology and pesticides.

4. **Summary Report**: All students are required to prepare a written summary of the field work to be submitted with this evaluation form.

3/31/17

Student Signature Date