Poisons on the Wind

Community Air Monitoring for Chlorpyrifos in the Yakima Valley

A report by Farm Worker Pesticide Project and

Pesticide Action Network North America

December 2006

"Information is the currency of democracy."

Thomas Jefferson

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Views and analyses are those of the authors, the Farm Worker Pesticide Project and Pesticide Action Network North America, and do not necessarily reflect the views or opinions of our funders.

Corrections and Addendum

Text on pages ii, iii, 4-6, and 19 was edited on December 14 and 20, 2006.

The Columbia University Mailman School of Public Health published an important new study after this report was printed: V. Rauh, R. Garfinkel, F. Perera, *et al*, Impact of Prenatal Chlorpyrifos Exposure on Neurodevelopment in the First 3 Years of Life Among Inner-City Children, *Pediatrics*, 2006, 118(6): 1845-1859. According to the School's news release about the study on December 4, 2006 "Children who were exposed prenatally to the insecticide chlorpyrifos had significantly poorer mental and motor development by three years of age and increased risk for behavior problems."

An Executive Summary of this report is available in Spanish

Resumen Ejecutivo — ***Aires envenenados: Monitoreo del clorpirifos en el aire del Valle Yakima: Proyecto autogestionado por la comunidad.*** Comuníquese con Carol Dansereau, NB 3, 5031 University Way NE, Seattle, WA 98105; 206-729-0498. cdansereauFWPP@earthlink.net; Manuel Perez, Suite 10A, 3601 W. Washington Ave., Yakima, WA 98903; 509-575-3934; www.fwpp.org

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Executive Summary

I. Why We Tested: Trouble in Paradise

In the spring of 2006, farm worker community members tested the air at two different locations in the Yakima Valley with the assistance of the Farm Worker Pesticide Project (FWPP) and Pesticide Action Network (PAN). We tested for dangerous levels of chlorpyrifos, the key ingredient in the insecticide Lorsban, which is widely used in apple, cherry and pear orchards.

Three factors prompted our decision to monitor the air:

We knew that chlorpyrifos is very dangerous, especially for children

Chlorpyrifos is an acutely toxic insecticide and one of the more thoroughly studied pesticides among organophosphates, a class of chemicals that damage the nervous system. The U.S. Environmental Protection Agency (EPA) banned the use of chlorpyrifos in residential products in 2000 because of the high risks it poses to children.

There were many reasons to suspect that chlorpyrifos was in the air in significant concentrations

- Community members described regularly seeing, smelling and feeling drifting pesticides during Lorsban season.
- Numerous dust and urine studies in Washington State provided strong evidence of widespread chlorpyrifos drift.
- Dangerous concentrations of chlorpyrifos in air have been measured near high use sites in California.
- Government reports of pesticide poisonings in Washington State included many drift cases, including chlorpyrifos cases.
- Blood tests for pesticide handlers implicated airborne chlorpyrifos as a public health hazard. Many of the workers tested under Washington's Medical Monitoring Program who experienced significant nervous system impacts had been involved in airblast applications of Lorsban.
- Large volumes of chlorpyrifos are applied to fruit trees in Washington State each year.

In short, there was ample reason to be concerned that high levels of chlorpyrifos might be in the air that workers, their children and other agricultural neighbors are breathing.

Government agencies responsible for protecting health refused to monitor the air or take action against drift

Farm Worker Pesticide Project and others asked the Washington State Department of Agriculture (WSDA), the Governor, and U.S. EPA to establish an air monitoring program in Washington State. Our requests have not been granted. At the same time, government agencies have rejected our appeals for action against drift, dismissing our concerns about health as unwarranted. Farm worker community members and public interest allies had little choice but to move forward with our own monitoring.

II. How We Tested: Communities Empowered with Equipment, Training and Assistance

Pesticide Action Network developed a "Drift Catching" program to assist groups throughout the United States who want to measure levels of pesticides in the air. The "Drift Catcher" is a device developed by PAN staff, led by chemist Dr. Susan Kegley, with input from a scientific advisory committee comprised of representatives from academia, US EPA, the California Department of Pesticide Regulation, and the California Department of Health Services. It is similar to and validated against related devices used by regulators and researchers for air sampling.

To ensure monitoring is conducted according to standard protocols, PAN provides detailed training and certification for using the Drift Catcher. Farm Worker Pesticide Project staff were trained, and in turn trained community volunteers in Washington with help from PAN. PAN and an independent commercial scientific laboratory analyzed the air samples to assure reliable results.

FWPP and PAN provided assistance to farm worker community members who tested the air at two different locations in the northern Yakima Valley. Twenty-four-hour air samples were taken at community members' homes for three weeks in April of 2006.

III. What We Found: Poisons on the Wind

Cowiche: Chlorpyrifos in the air every day and exceeding "acceptable" levels for children's health on at least six days

The Cowiche Drift Catching project was carried out by a former farm worker in the backyard of the home he shares with his wife and three children (ages 3, 8 and 12). An apple orchard is located behind the neighbor's yard, 57 feet from where the Drift Catcher was set up.

Chlorpyrifos was present in the air in the family's yard on each of the 21 days on which testing occurred. Based on samples analyzed by the PAN laboratory, there were eight days (38% of the time) when levels of pesticides in the air exceeded the 24-hour acute and sub-chronic chlorpyrifos Reference Exposure Level or REL, a concentration equivalent to an "acceptable" dose according to EPA (see box below, right) for one-year-olds. Duplicate samples analyzed by EMA, a commercial laboratory, showed six days (29% of the time) when air levels were above the "acceptable" level. The highest concentration measured for a 24-hour period was on April 12, 2006, at 572 ng/m^3 or 3.4 times the acute child REL.

Prevailing winds, checked once each day, shifted several times during the 3-week sampling period. The house was predominantly upwind of the orchard from April 3-10, downwind from April 11-16, and no predominant wind direction was noted from April 17-23. Peak concentrations correlated with winds blowing from the orchard.

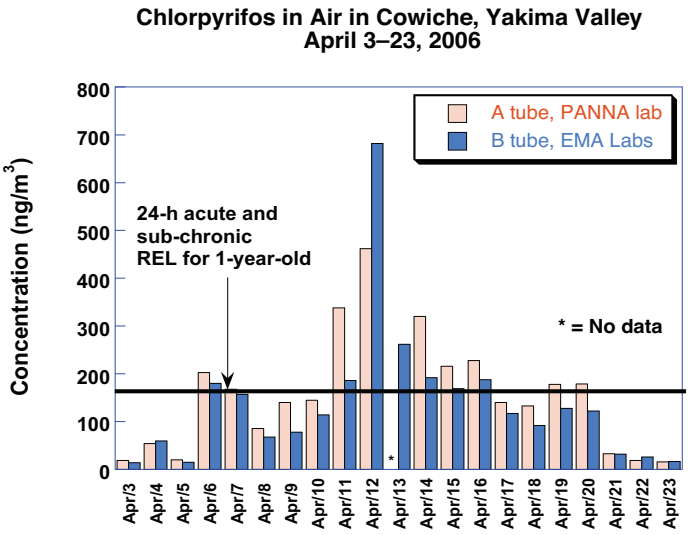


Figure 1: Chlorpyrifos concentrations in Cowiche, April 3-23, 2006. REL = Reference Exposure Level calculated from US EPA's "acceptable" daily dose for acute and sub-chronic exposures (see **Appendix 2**). EMA Labs results were corrected to account for average recoveries of 65%.

Tieton: Chlorpyrifos in the air every day and exceeding "acceptable" levels for children's health on eight days

The Tieton air monitoring was done at the home of two farm workers. At the time of the testing, the family had three children (ages 2, 5 and 8) and the mother was pregnant with a fourth child. The Tieton home is surrounded by orchards, with the nearest being less than 46 feet from the house. The Drift Catcher was set up immediately next to the house at a point that was 46 feet from the nearest orchard trees and the sample tubes were changed daily for three weeks. Winds were light and variable during the sampling period.

Chlorpyrifos was detected on each sampling day. On eight days (38% of the time), levels exceeded the 24-hour acute and sub-chronic Reference Exposure Level (REL) for children. The highest concentration observed for a 24-hour period was on April 13, 2006 at 475 ng/m^3 (2.8 times the 24-hour acute child REL).

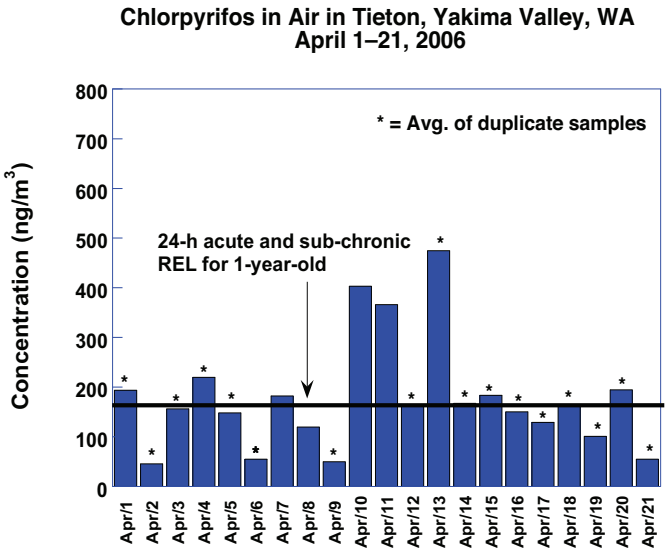


Figure 2: Chlorpyrifos concentrations in Tieton, April 1-21, 2006. REL = Reference Exposure Level calculated from US EPA's "acceptable" daily dose for acute and sub-chronic exposures.

"Reference Exposure Levels" (RELs) are levels of a pesticide in the air below which no adverse health effects are expected to occur, based on animal toxicity studies. The "24-hour acute REL" is the "acceptable" concentration of a pesticide in the air for 24 hours. The "sub-chronic REL" is the "acceptable" concentration over an intermediate time period, typically one month to several years.

Parents are worried about their children's health

Organophosphates, including chlorpyrifos, are nerve poisons that can cause many acute and chronic health impacts. The families that hosted the Drift Catcher are concerned about the risks posed to their health, and especially that of their children, by chlorpyrifos in the air. The Tieton and Cowiche families try to stay inside when the parents notice applications underway.

But our results showed that there are *many* days during chlorpyrifos spray season when the air is not safe to breathe. Parents may not be aware of all applications near their homes, and may not be able to take this protective action on all the days it is needed. It is also unclear as to whether there is chlorpyrifos in the air inside the home, and if so, at what levels. Family members may also be exposed to drift residues on toys, windowsills and other property.

The proximity of our testing sites to chlorpyrifos applications is not unusual

Homes, daycares, schools, and workplaces are often as close or closer to orchards than are our test sites. Thus, our results are highly relevant to vast numbers of individuals in agricultural areas. People may also be inhaling chlorpyrifos at many different locations including home, school, daycare or work. They may be exposed to this pesticide through sources other than drift such as contact with people who have worked with pesticides or in pesticide-treated areas that day.

A Drift Catcher positioned by one of the homes in the study, located close to an orchard where chlorpyrifos is applied. Many homes are located within yards of orchard trees.

Yakima Valley air concentrations are similar to those measured in California

Our findings are consistent with data from the California Air Resources Board air monitoring, which indicates widespread exceedances of "acceptable" levels of chlorpyrifos for children in areas of high chlorpyrifos use. The results are also consistent with projections about drift and health risks calculated by scientists using mathematical drift models.

IV. Health Effects: The Air is Not Safe to Breathe

"Acceptable" levels of chlorpyrifos in the air were frequently exceeded, creating a high potential for health effects

Chlorpyrifos has been studied thoroughly. It and other organophosphates are neurotoxicants that can depress levels of cholinesterase, an important enzyme in the nervous system. Cholinesterase inhibition is associated with a wide array of serious symptoms.

At lower exposures, people may experience nausea, dizziness, difficulty thinking, headaches, difficulty breathing and other problems. At higher levels, they may experience convulsions, respiratory distress, other severe symptoms, and even death. Fetal exposures to chlorpyrifos results in developmental neurotoxicity, reducing the number of neural connections formed in the brain.

Our air testing found that on many days at each location, children were exposed to chlorpyrifos at concentrations above Reference Exposure Levels—concentrations below which no health effects may be anticipated from short-term and seasonal exposures in children. Thus there is potential for children to be inhaling this insecticide and experiencing health effects such as the acute and chronic effects listed above.

Exposures below "acceptable" levels are not necessarily safe

The currently "acceptable" dose of chlorpyrifos is based on only one mechanism by which chlorpyrifos may cause harm. Yet there is extensive and compelling scientific data showing that chlorpyrifos and other organophosphates injure people, especially developing babies, through other mechanisms as well. In addition, exposures to many different organophosphates may add to the cumulative risk that individuals are experiencing.

There is strong evidence that chlorpyrifos may be causing neurological injury and more

Scores of animal studies have now documented significant neurological changes from chlorpyrifos exposures, such as fewer brain cells, reduced brain weight, abnormalities in synaptic communication and other changes from organophosphate exposures, and in particular from chlorpyrifos exposures. New *human* studies provide strong evidence that people are being adversely affected in agricultural communities as well. For example, farm workers and their children have performed more poorly than comparison groups on neurological tests in recent studies. Poorer performance was associated with higher levels of organophosphate metabolites measured in workers' urine. Chlorpyrifos exposure has also been linked to lung cancer, asthma, and hormone disruption.

We need a health-protective approach to pesticide regulation

No one knows the full breadth of impacts that chlorpyrifos and other drifting pesticides may have on the countless individuals inhaling them. We cannot allow these exposures to continue, both because of what we do know about the health impacts of chlorpyrifos and other pesticides, and because of what we do *not* know.

V. Government's Response: Refusing to Look, Refusing to Act

Given state and federal statutes that are supposed to protect people's health, how can the conditions documented by our testing exist?

Flying blind: Vital information is missing.

Without data on pesticide use and airborne pesticide levels after routine applications, it is impossible for government agencies to carry out their mandates to protect health. Nonetheless, state and federal governmental bodies have ignored requests to provide vital information about pesticides on three important fronts: air monitoring, pesticide use reporting, and notification.

Refusing to monitor the air

State and federal agencies have failed to establish an air monitoring program in Washington State despite requests from Farm Worker Pesticide Project and others. Based on the costs of air monitoring in California, a good initial air monitoring program could probably be established in Washington for $500,000 or less. For an additional $3,000 the state could buy five Drift Catchers for use by inspectors charged with enforcing pesticide regulations.

Keeping pesticide use secret

California not only monitors the air, it also requires growers to report their pesticide use. Washington State residents, however, cannot obtain information on the pesticides that have been applied near their homes, schools and workplaces. This stymies our ability to obtain proper medical diagnoses, and to seek enforcement when poisoning incidents occur. It limits researchers' abilities to study whether incidence of disease may be connected to pesticide exposures.

Denying neighbors notice prior to applications

Currently, pesticide applicators are not required to provide notice to neighbors prior to pesticide applications, even for applications of the most drift-prone and most acutely toxic pesticides. In the absence of notice, people cannot minimize their exposures by closing windows or leaving the area. Those who are exposed and affected by drift may not realize what has occurred and thus may not obtain accurate medical diagnoses and treatments.

Washington State Department of Agriculture (WSDA) proposed a limited notice rule in 2005. The agency withdrew the rule, however, despite a full public comment process in which hundreds of people commented in favor of notification.

In short, state and federal governments have opted to keep people in the dark and to try to keep pesticide exposures and their impacts on individuals and communities invisible.

Failing to enforce the law against drift exposure

Under state law it is illegal for someone to handle agricultural pesticides in a manner that allows the pesticide to contact people not involved in the application, directly or through drift. Our air monitoring results and other data indicate that this requirement is potentially being violated on a massive scale. Nothing is being done to protect people from these exposures—not by the Washington State Department of Agriculture, not by EPA, and not by other state or federal agencies.

Instead of stepping up enforcement, in recent years state agencies responsible for enforcing pesticide regulations have undermined public confidence in their ability to require applicators to eliminate drift to adjacent properties. WSDA management removed an effective inspector under pressure from growers; made it harder for inspectors to enter orchards to investigate potential problems; failed to provide air monitoring equipment to inspectors; and failed to uphold inspectors' penalties in an egregious drift case. While EPA has oversight authority over WSDA, it has failed to use that authority to object to these actions and to insist upon full enforcement.

A more basic problem with the current system is that, for most pesticides, EPA does not account for exposure from breathing pesticides when it conducts a risk assessment, the process on which all regulation of pesticides is based.

Failing to adopt new protections

Farm Worker Pesticide Project and others have long called for stronger policies to address drift such as:

1) No-spray buffer zones around unprotected workers, daycare centers, homes, and schools;

2) Prohibitions on applications when wind speeds exceed five miles per hour on average and when gusts exceed ten miles per hour;

3) Restrictions on the use of drift-prone technologies such as air blast sprayers; and

4) Phase-out timelines for the most dangerous pesticides and measures to assist growers in transitioning to safer alternatives.

WSDA has failed to take any of these actions and has refused to foster public discussions on these matters.

At the federal level, despite banning residential use of chlorpyrifos, EPA recently reauthorized use of this pesticide in agriculture. It has also extended the use of another dangerous organophosphate, azinphos methyl, on apples and certain other crops for another six years.

In summary, federal and state agencies that are supposed to protect public health from pesticides have failed to use their authority to do so. At the state level, one factor may be an inherent conflict of interest at WSDA, the state agency that is primarily responsible for pesticide management in Washington State. WSDA is responsible for both promoting agriculture and regulating it. The *Wenatchee World* editorial board noted in an editorial in June of 2005, "It may be time to consider spinning off the Department of Agriculture's law enforcement role to another agency."

VI. A New Vision for Growing Food

Many growers in Washington State, such Adolfo Alvarez, do not use chlorpyrifos, and many are entirely organic. They do not put their workers and neighbors at risk of drift and other exposures, yet they farm successfully.

Only limited governmental resources are dedicated to promoting sustainable agriculture, however. And little has been done to systematically identify the barriers that prevent more growers from switching to alternatives such as those used by Mr. Alvarez and others.

The solution to the economic challenges facing growers is not to ignore the exposures and health risks associated with reliance on highly toxic pesticides. Instead, we must join together both to better protect health and to make farms more sustainable. There are long-term economic benefits to growers associated with reducing reliance on conventional pesticides. Our organizations look forward to discussions with growers and others to develop real solutions that end toxic exposures and protect farms by promoting sustainable agriculture.

VII. Recommendations

Farm worker community members and public interest organizations have helped shine a light on a matter that has been kept in the dark for too long. In the absence of government testing of pesticides in air, we have conducted air monitoring ourselves. Our findings document what we have long suspected: the air is not safe to breathe, particularly for our children. We call upon our government leaders to act immediately to protect us from further harm.

We call upon Governor Gregoire to:

1) Direct the Department of Agriculture, the Department of Ecology, the Department of Health, and the Department of Labor & Industries to establish an air monitoring program.

   Specifically, they must require air monitoring for chlorpyrifos and other pesticides in agricultural areas and secure funding for this program in the upcoming legislative session. Monitors should be operated during times of high pesticide use, gathering comprehensive data regarding airborne pesticides at homes, daycares, schools, and workplaces. The Department of Health should be designated as the agency that analyzes and explains the testing results in the context of available data regarding health risks for children and adults.

2) Launch an Alternatives Assessment at the Center for Sustaining Agriculture and Natural Resources at Washington State University, and secure funding for this assessment in the upcoming legislative session.

   This assessment should review the availability of safe alternatives for chlorpyrifos and the other pesticides most affecting farm workers, their families and others in agricultural areas. The assessment should identify areas in which additional research for alternatives is needed. It should also identify barriers that prevent

growers from using alternatives, and provide steps that can be taken to remove those barriers and otherwise help growers make transitions to alternatives. Farm workers and other drift victims, as well as growers, must be actively involved in design and implementation of the assessment.

3) Establish a new direction at WSDA and/or support reorganization that removes public health protection responsibilities to a different agency more able to carry out those responsibilities.

4) Direct WSDA to immediately adopt an expanded notice rule providing prior written notice to workers, residents, daycare centers, nursing homes, schools, and all individuals within a specified distance prior to dangerous pesticide applications.

5) Direct WSDA and the Department of Labor & Industries to provide air monitoring equipment to inspectors and to develop and implement strategies for enforcement against drift.

6) Direct the Department of Health to take a more visible leadership role on the issue of exposures to agricultural pesticides and the need for new policies and enforcement to protect health. DOH should review and report upon new data on exposures and health effects, and the implications for policies and enforcement in the state. The agency should take health-protective positions on proposed rules and legislation related to agricultural pesticide issues, and it should propose rules and legislation to reduce and prevent exposures.

7) Greatly increase funding for sustainable agriculture programs to replace chlorpyrifos and other pesticides with safer ways of controlling pests.

8) Establish realistic yet rapid timelines for phasing out the most dangerous pesticides, including chlorpyrifos and azinphos-methyl.

We call upon the U.S. EPA:

1) Phase out chlorpyrifos and other organophosphates.

2) End the use of azinphos methyl immediately.

3) Greatly increase funding for and focus on developing and promoting sustainable agriculture and alternatives to pesticides.

4) Engage in meaningful oversight of states' implemention of federal pesticide laws. EPA should immediately initiate a review of WSDA's implementation of pesticide laws in Washington, and recent actions by the agency outlined in this report that undercut its ability to enforce laws and protect health. Strong enforcement must be a condition for continued delegation of pesticide enforcement authority to the state.

5) Account for near-field inhalation exposures when conducting risk assessments.

6) Establish air monitoring of agricultural pesticides directly and through delegated states. EPA should require air monitoring as part of each delegated state's implementation of pesticide laws. It should provide training and financial assistance to facilitate air monitoring.

We call upon the Washington State Legislature to:

1) Establish and fund air monitoring of agricultural pesticides.

2) Establish and fund the Alternatives Assessment process discussed above in Recommendation 2 to Governor Gregoire.

3) Greatly increase funding and staffing for developing and promoting alternatives to pesticides at state agencies and academic institutions.

4) Require Labor & Industries and WSDA to develop and implement a phase-out program for the most dangerous agricultural pesticides.

5) Support placement of public health protection authority regarding pesticides in an agency focused on public health protection.

We call upon grower organizations to:

Work with farm worker and community organizations towards policies and programs that will protect health and the long term viability of farming in Washington.

Poisons on the Wind

I. Why We Tested: Trouble in Paradise

The farming areas of rural Washington State offer scenes of unparalleled beauty in which to live and work. Trees laden with blossoms or fruit, and a growing acreage of vineyards, provide a picturesque backdrop to homes and schools. Large expanses of green promise crops that will feed millions at harvest time and generate significant income for members of the farming community.

But all is not well in agricultural lands. Many growers rely on highly toxic chemicals to control insects, weeds and other pests. Unfortunately, many of these chemicals can also cause illness in those who are exposed. Current pesticide use practices place children and adults at risk of exposures that pose threats of serious short-term and long-term health effects.

In the spring of 2006, farm worker community members tested the air at two different locations in the Yakima Valley with the assistance of the Farm Worker Pesticide Project (FWPP) and Pesticide Action Network (PAN). We tested for chlorpyrifos, the key ingredient in the insecticide Lorsban. Three factors prompted our decision to monitor the air: the serious health hazards associated with chlorpyrifos, the likelihood of it being in the air in significant concentrations, and our government's refusal to do testing itself.

We knew that chlorpyrifos is very dangerous, especially for children

Chlorpyrifos is one of the more thoroughly studied pesticides among organophosphates, a class of chemicals that damage the nervous system. Small doses can lead to serious and potentially permanent health problems, and in extreme cases, death. The United States Environmental Protection Agency (EPA) banned the use of chlorpyrifos in residential settings in 2000 because of the high risks it poses to children. Since that time, even more compelling studies have emerged providing additional evidence of the dangers of chlorpyrifos to the developing nervous system in the fetus, infants and children.

There were many reasons to suspect that chlorpyrifos was in the air in significant concentrations

Substantial evidence had already accumulated establishing the likelihood of frequent high levels of exposure for farm workers, their children and others living or working in agricultural areas.

Community members described regular exposures to chlorpyrifos and other pesticides.

People indicated that they frequently see, smell or feel pesticides drifting from fields and orchards near their workplaces and homes.

Numerous dust and urine studies in Washington State provided strong evidence of widespread drift of chlorpyrifos.

In many different studies, researchers have found organophosphates, including chlorpyrifos, in house dust in the homes of workers and others in agricultural areas. They also found the breakdown products of these pesticides in the urine of workers and their children. The studies provided evidence that exposure was occurring because of pesticides brought home on parents' clothes, skin and hair. The researchers also clearly indicated that drift was an additional major factor contributing to exposures. The concentrations of pesticides in house dust increased with proximity to orchards, and the homes, and children of non-agricultural workers as well as those of agricultural workers were found to be contaminated (see Appendix 1 for specific details and references for some of these studies.)

Air monitoring in California had documented high levels of chlorpyrifos in the air, indicating vast numbers of children at risk of health effects.

The California Air Resources Board (CARB) has monitored the air for chlorpyrifos and other pesticides using equipment placed on the roofs of schools and other community buildings, as well as directly adjacent to application sites. Based on CARB data, scientists at the Califor-

nia Department of Health Services concluded in a study published in 2002 that:

> ". . . short-term chlorpyrifos exposure estimates exceeded the acute reference value for 50% of children" in the *general* population near the monitors. [1] (The "reference value" is a level above which health effects can be expected based on extrapolations from laboratory testing. See p. 3 How Much is Too Much? on Reference Exposure Levels for more details.)

The scientists noted that combining the results of their analysis with census data suggest a potential for similar exposures and risks "for hundreds of thousands of people in California." They pointed out that farm workers and their children may be at higher risk than the general population and urged Washington State to pay heed to their results given parallels in pesticides usage in Washington.

An airblast sprayer applying pesticides to an orchard (PAN)

Pesticide Incident Reporting and Tracking (PIRT) reports indicated that chlorpyrifos drift is a major problem in Washington State

The state of Washington tracks pesticide poisoning incidents and provides a summary report to the public called the Pesticide Incident Reporting and Tracking (PIRT) report. While these reports are likely to reflect only a small percentage of actual pesticide-induced illness cases, they do provide a guide to problematic chemicals and situations. The 2004 PIRT Report highlighted pesticide drift as an ongoing problem and a PIRT Review Panel target for action.[2]

From 2000 through 2004 there were 172 illness cases classified by the Washington State Department of Health (DOH) as definitely, probably or possibly due to pesticide drift. Of these, 81 involved workers, generally farm workers. Ninety-one involved people in their homes, driving on roads, in parks, etc.[3] These 172 cases did not include illnesses associated with direct spray.[4] Nor did they include those cases associated with residues on plants or property, although these may have been deposited from drift in some instances. See Appendix 3 for examples of chlorpyrifos drift cases included in recent PIRT reports and for information on why reported cases represent only a small percentage of actual pesticide-induced illnesses.

Washington State's medical monitoring program implicates airborne chlorpyrifos as a public health hazard

Under the State's Medical Monitoring Program, workers who regularly handle organophosphates (OPs) or carbamate pesticides (CBs) must be offered medical monitoring by their employers.[5] Blood tests prior to the beginning of the pesticide application season establish the normal "baseline" levels of cholinesterase, an important nervous system enzyme in their bodies. Follow-up tests after workers handle OPs or CBs are used to determine whether cholinesterase levels have dropped, an outcome associated with exposures to those sorts of pesticides. The percentages of workers with significant (greater than 20%) declines in cholinesterase after handling pesticides were 21%, 10% and 12% in 2004, 2005, and 2006 respectively.[6]

In all three years of the program, chlorpyrifos was implicated as a primary potential cause of cholinesterase depressions.[7] In addition, almost all significant depression cases involved the use of airblast sprayers.[8] Pumps on these sprayers deliver pesticides into an air stream created by a large fan at the back of the sprayer. The 2005 PIRT report highlights that the high pressure spray of airblast sprayers is prone to drift.[9]

The medical monitoring results raise concerns about airborne chlorpyrifos not only for pesticide handlers but also for others working or living near applications. Even with respirators and other protective gear, handlers experience significant nervous system impacts associated with airblast applications of chlorpyrifos. Individuals nearby who lack protective gear may face risks that are as high or even higher than those of the handlers.

Large quantities of chlorpyrifos are applied in Washington State each year

In 2003, 269,000 pounds of chlorpyrifos were applied to apples, cherries and pears in Washington State.[10] Sixty-three percent, 57 % and 42 % of the acres for each of those crops respectively were treated with chlorpyrifos. In 2005, 226,400 pounds of chlorpyrifos were applied to apples, cherries and pears in the state.[11] The percentage of acres to which chlorpyrifos was applied was 58, 44, and 22 for apples, cherries and pears respectively. It is unclear whether the decline from 2003 to 2005 is a long-term trend or just normal fluctuation in use. See Appendix 4 for more details on chlorpyrifos use in Washington State and nationwide.

In short, there was ample reason to be concerned that chlorpyrifos might be in the air that workers, their children and other agricultural neighbors are breathing at high levels.

Community experiences, dust and urine studies, air monitoring in California, cholinesterase monitoring results, PIRT reports, and the sheer volumes of chlorpyrifos released to the environment near homes, generally via airblast sprayers, all indicated that chlorpyrifos in the air might be posing health hazards for community members.

Government agencies responsible for protecting health refused to monitor the air or take action against drift

Even in the face of all of the information pointing to real problems with airborne chlorpyrifos and without gathering any data that would facilitate informed decision-making, agency officials dismissed our concerns about health as unmerited. They consistently rejected our appeals for increased monitoring and protections against drift (see Section V below for details).

Thus, farm worker community members and public interest allies had little choice but to move forward with our own monitoring. We knew that dangerous drift-prone pesticides were being used near children and others, and that exposures at high levels were likely. Our government was ignoring the situation and perpetuating its invisibility. We needed to gather information on airborne pesticides ourselves.

Pesticide Incident Reporting and Tracking
Case Number 030035, April 5, 2003

"A 9 y/o male and 67 y/o female developed neurological, ocular and respiratory symptoms after their homes were drifted on."

Washington State Dept. of Health, 2004 Annual Report, Pesticide Incident Reporting and Tracking (PIRT) Review Panel, p. 274.

How Much is Too Much?

Reference Exposure Levels

A Reference Exposure Level (REL) is the concentration of a chemical in the air that agencies conducting risk assessments generally consider "acceptable" for a given exposure scenario (acute, sub-chronic, or chronic). The REL is deemed the level below which no adverse health effects are anticipated, based on toxicity studies that have been done in laboratories with animals. Exposures above the REL have the potential to cause adverse health effects. In this report, the REL is expressed in nanograms of pesticide per cubic meter of air (ng/m^3). A nanogram is one billionth of a gram and a cubic meter of air is about the size of a large television.

Acute REL: The "acceptable" concentration of a pesticide in air for a short time period, typically one to 24 hours.

Sub-chronic REL: The "acceptable" concentration of a pesticide in air for an intermediate time period, typically one month to several years.

Chronic REL: The "acceptable" concentration of a pesticide in air over a long time period, typically several years to a lifetime.

In this study, we compared measured concentrations of chlorpyrifos in air to the acute and sub-chronic RELs for a 7.6 kg (17 pound) child (average weight of a one-year-old). See Appendix 2 for details. As is discussed in this report, data from California and our own testing results include 24-hour periods when concentrations exceeded RELs.

The current REL for chlorpyrifos may not be adequately protective because it was not based on the most sensitive toxic effect observed in animal studies and because children and adults are exposed to other organophosphates and other pesticides which may act in an additive or synergistic way.

The term "reference value" or "reference concentration (RfC)" is sometimes used instead of REL.

"Anita's" Story

Example of a pesticide illness case not in PIRT Reports:

"Please, don't use my name," the woman requested. So we'll call her Anita in this report. She had been very hesitant to meet with representatives of the Farm Worker Pesticide Project to share her story, canceling once, but then finally meeting us at a park in Yakima. Anita described what had happened in the summer of 2004 while she was thinning apples. About 50 feet away, a tractor was spraying a pesticide—which one, she didn't know. The pesticide was picked up by the wind and carried to her and about 20 other workers.

The workers asked the supervisor if there was any danger, and he assured everyone that everything was under control. But within a few minutes, Anita was vomiting and had a headache. A red rash broke out on her arms and face. She was too afraid of losing her job to complain. After work she called a friend who suggested drinking lemon water, which she did. Anita did not visit a doctor. She missed the next day of work, and returned the day after that.

II. How We Tested: Communities Empowered with Equipment, Training and Assistance

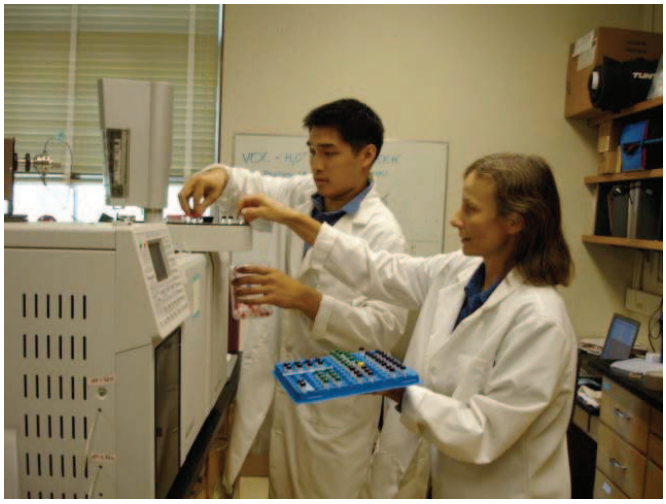
Pesticide Action Network (PAN) operates a "Drift Catching" program, offering assistance to groups throughout the United States who want to measure levels of pesticides in the air. The "Drift Catcher" was designed by Dr. Susan Kegley, a PhD chemist on staff at PAN, and others at PAN, with input from an advisory committee of scientists with experience in air monitoring (from academia, US EPA, and California Departments of Pesticide Regulation and Health Services). PAN started with the air monitoring equipment used by the state of California and adapted it for use by community members. Each Drift Catcher costs approximately $600.

To ensure proper use of the equipment and sample handling procedures, PAN provides detailed training and a certification test for those who will be involved in drift catching. A Drift Catcher manual is given to participants, including a version in Spanish, for those who need it. FWPP staff participated in trainings provided by PAN scientists in California and in Washington State.

Training covers how and when to set up air monitoring equipment, how and when to change sample tubes, how to measure conditions such as wind speed and direction, proper storage and transportation of sample tubes, the use of quality control techniques, and how to record necessary data on appropriate forms. The Drift Catcher takes two samples simultaneously, providing a backup sample and/or an opportunity to test the reproducibility of the results. For our project, duplicate samples were analyzed by a commercial laboratory (Cowiche) or PAN's laboratory (Tieton) for comparison.

Farm worker community members set up a Drift Catcher

FWPP engaged in outreach to the farm worker community and explained to interested individuals that Drift Catchers, training and assistance were available. We then held training workshops for community members interested in using Drift Catchers to find out what is in the air they and their families breathe. Both Cowiche and Tieton residents attended a training workshop and conducted sampling in the spring of 2006, taking 24-hour samples for three weeks during a season of high chlorpyrifos use. See Appendix 7 for details.



PAN's Dr. Kegley & Andrew Wang analyzing air samples

III. What We Found: Poisons on the Wind

Cowiche: Chlorpyrifos in the air every day and exceeding "acceptable" levels for children's health on at least six days

The Cowiche Drift Catching project was carried out by a former farm worker in the backyard of the home he shares with his wife and three children (ages 3, 8 and 12). An apple orchard is located southwest of the family's home, approximately 19 feet from their yard, and 115 feet from their house. The Drift Catcher was set up next to the garage 57 feet from the orchard.

View of garage, drift catcher and orchard in Cowiche (FWPP)

Winds, checked once each day, blew predominantly from the east or northeast from April 3-10. Thus, our testing location was generally upwind of applications that might have occurred on the orchard nearest to it during this time period. From April 11-16, the period when peak concentrations were observed, winds were out of the southwest, with the house now downwind of the orchard. No predominant wind direction was noted April 17-23.

One set of samples was analyzed by PAN's laboratory, with duplicate samples analyzed by a commercial laboratory for comparison. Chlorpyrifos was present in the air in the family's yard on each of the 21 days on which testing occurred, with a spike in concentrations mid-way through the testing, indicating that an application had taken place nearby and/or the wind had changed direction. If it were an application, it is not possible to determine if it took place at the adjacent orchard or an orchard further away. If pesticide use reporting were required in Washington State, it would be possible to analyze how the spike correlates to spraying that occurred at the nearby orchard and to spraying at other area orchards.

Based on samples analyzed by the PANNA laboratory, there were eight days (38 % of the 21 days) on which the levels of pesticides in the air exceeded the 24-hour acute and sub-chronic chlorpyrifos Reference Exposure Level (REL) for one-year-olds (RELs and their significance are discussed on p. 3). There was an additional day during which the chlorpyrifos concentration was just under the REL.[12] Duplicate samples analyzed by EMA laboratory showed six days (29%) with air levels above the REL, and a seventh when the level was just under the REL.[13] Results are presented in Figure 1. The highest concentration measured for a 24-hour period was 572 ng/m^3 (3.4 times the 24-hour acute child REL) on April 12th.

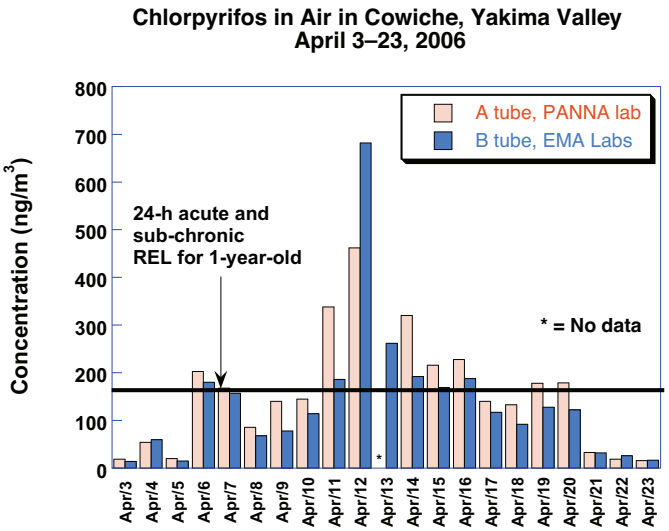


Figure 1: Chlorpyrifos concentrations in Cowiche, April 3-23, 2006. REL = Reference Exposure Level calculated from US EPA's "acceptable" daily dose for acute and sub-chronic exposures (see Appendix 2). EMA Labs results were corrected to account for average recoveries of 65%.

Tieton: Chlorpyrifos in the air every day and exceeding "acceptable" levels for children's health on eight days

The Tieton air monitoring was done at the home of two farm workers. At the time of the testing, the family had three children (ages 2, 5 and 8) and the mother was pregnant with a fourth child. The Tieton home is surrounded by orchards, with the nearest being less than 46 feet from the house. The Drift Catcher was set up immediately next to the house at a point that was 46 feet from the nearest orchard trees and the sample tubes were changed daily for three weeks. Winds were light and variable during the sampling period.

All samples, including most duplicates, were analyzed in the PANNA laboratory. Averages for each day's duplicate samples are presented in Figure 2. Chlorpyrifos was detected on each sampling day, and on eight days (38% of the days), measured levels exceeded the 24-hour acute and sub-chronic Reference Exposure Level (REL) for children. On three additional days, concentrations were just below the REL[14]. The highest concentration for a 24-hour period was 475 ng/m^3 (2.8 times the 24-hour acute child REL) on April 13th.

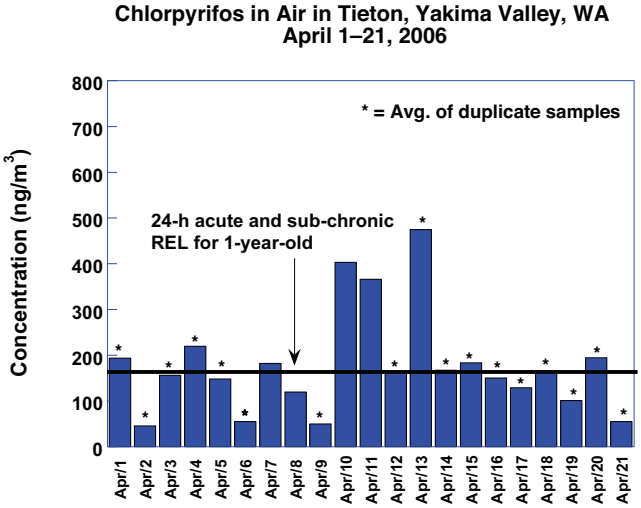


Figure 2: Chlorpyrifos concentrations in Tieton, April 1-21, 2006. REL = Reference Exposure Level calculated from US EPA's "acceptable" daily dose for acute and sub-chronic exposures (see Appendix 2).

Orchard from back of house in Tieton (FWPP)

Parents are concerned for their children's health

The families that hosted the Drift Catcher are concerned about the risks posed to their health, particularly that of their children, by chlorpyrifos in the air. Because the families lived in the homes throughout the testing period, when outside they were inhaling chlorpyrifos at approximately the same levels as those we measured. Exact exposures are related to how much time they spent at the home and the magnitude of other exposures from food, water and residues they might have experienced. Dermal (skin) exposures from direct contact with chlorpyrifos in the air and from contact with residues deposited on the ground, toys, cars, and other personal property are highly likely in this situation.

The Cowiche family wonders whether allergy-like symptoms family members sometimes experience may be associated with pesticide exposures. They worry about the possible effects chlorpyifos exposures may have on their long-term health and the ability of their children to learn.

The Tieton family has great concern for their unborn child, given the extra vulnerability of the fetus to adverse effects from chlorpyrifos. The parents in this family have made a practice of taking everyone inside and closing all the doors and windows when they notice that a pesticide application is underway. They have tried to stay inside until those applications have ended. Results from air monitoring in their yard,

however, indicate that there were high concentrations of chlorpyrifos in the air on many different days during three weeks of testing. It is unclear whether those concentrations were associated with applications of which the parents were aware.

Moreover, in California, analyses of chlorpyrifos air monitoring results combined with data from pesticide use reporting indicate that high air concentrations of chlorpyrifos can continue for days after applications end. Thus, the parents and children in this family would need to stay inside with the windows and doors closed for a very long time during chlorpyrifos season to reduce exposures. Our testing did not include indoor testing, and we do not know the degree to which closing doors and windows protects indoor air from contamination.

Both families are also well aware of the fact that chlorpyrifos is only one of many pesticides that may be in the air or in the dust at their home over the course of the year.

The proximity of our testing sites to chlorpyrifos applications is not unusual

Many homes in agricultural areas in Washington State are as close or even closer to orchards than those of our testing families. Many daycares, schools, nursing homes and other institutions are also situated in close proximity to orchards. Similarly, farm workers and other workers often find themselves working on land immediately adjacent to an application site. These workers may be inhaling similar or even higher concentrations of chlorpyrifos than those we measured. The unborn children of pregnant workers are particularly at risk from exposures. Studies have also shown that pesticide residues are often brought home on workers' clothes, skin and hair, contaminating their homes and children.[15] Those "take-home" exposures may be in addition to exposures experienced due to drift from nearby orchards.

In short, our results are highly relevant to vast numbers of individuals in agricultural areas. People may be inhaling chlorpyrifos at many different locations (home, school, daycare, work), and also may be exposed to it through sources other than drift such as contact with "take-home" pesticides.

Unknown pesticides being applied to the orchard in Cowiche after drift catching project had ended. Lack of pesticide use reporting and notice leave families in the dark about the chemicals that drift into their yards and homes. (FWPP)

Yakima Valley air concentrations similar to those measured in California

Our findings are consistent with data from California Air Resources Board (CARB) ambient air monitoring, which indicates widespread exceedances of the acute reference value for children.[16] The maximum measured 24-hour concentrations equaled or exceeded the child REL at four of the five monitoring sites in California and ranged from 0.23 to 4.8 times the child REL, exposures that may have acute neurotoxic effects in some children. Our measured concentrations are also consistent with projections about drift and health risks calculated using drift models.[17]

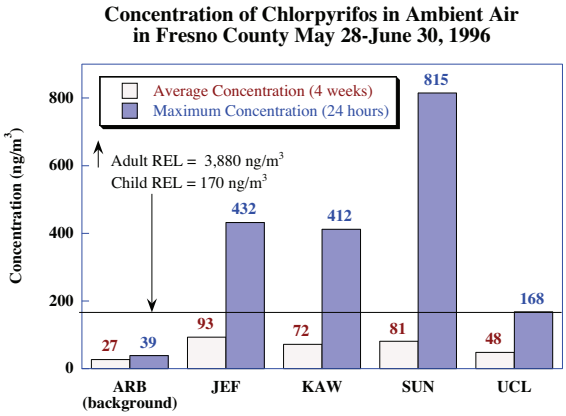


Figure 3: Monitoring data collected by CARB shows that four-and-a-half-week average chlorpyrifos concentrations in ambient air in Tulare County ranged from 16 to 55% of acute and sub-chronic RELs for a one-year-old child. Concentrations occasionally exceeded the child acute REL during a 24-hour monitoring period, with the maximum 24-hour concentration at each site ranging from 23 to 485% of the acute REL. Monitoring sites included ARB, the ARB office in downtown Visalia; JEF, Jefferson Elementary School in Lindsay; KAW, Kaweah School in Exeter; SUN, Sunnyside Union Elementary School in Strathmore; UCL, University of California, Lindcove Field Station.[18]

IV. Health Effects: The Air is Not Safe to Breathe

Toxic levels of chlorpyrifos in air were found, creating a high potential for serious effects

Chlorpyrifos and other organophosphates are nerve poisons that can depress levels of cholinesterase, an important enzyme in the nervous system. Cholinesterase inhibition is associated with a wide array of serious symptoms. At lower level exposures, people may experience nausea, dizziness, difficulty thinking, headaches, difficulty breathing and other problems. At higher levels, they may experience convulsions, respiratory distress, other severe symptoms, and even death. Appendix 3 presents cases of chlorpyrifos-induced health effects in children and adults that were included in PIRT reports.

In a review of organophosphates, Brenda Eskenazi, PhD of the University of California notes that "OPs that are insufficient to cause signs and symptoms of acute poisoning may also produce an influenza-type illness characterized by weakness, anorexia, and malaise."[19] People can easily attribute symptoms to the flu or other non-pesticide causes.

Our air testing found that on a large number of days at each location, children inhaled chlorpyrifos at concentrations above Reference Exposure Levels, where health effects may be anticipated from short-term and seasonal exposures in children. Thus there is a high potential in agricultural areas for children to be experiencing health effects from lower level exposures such as those listed above. Children are the individuals in our society least able to understand the reasons for how they feel and to be able to communicate about illness.

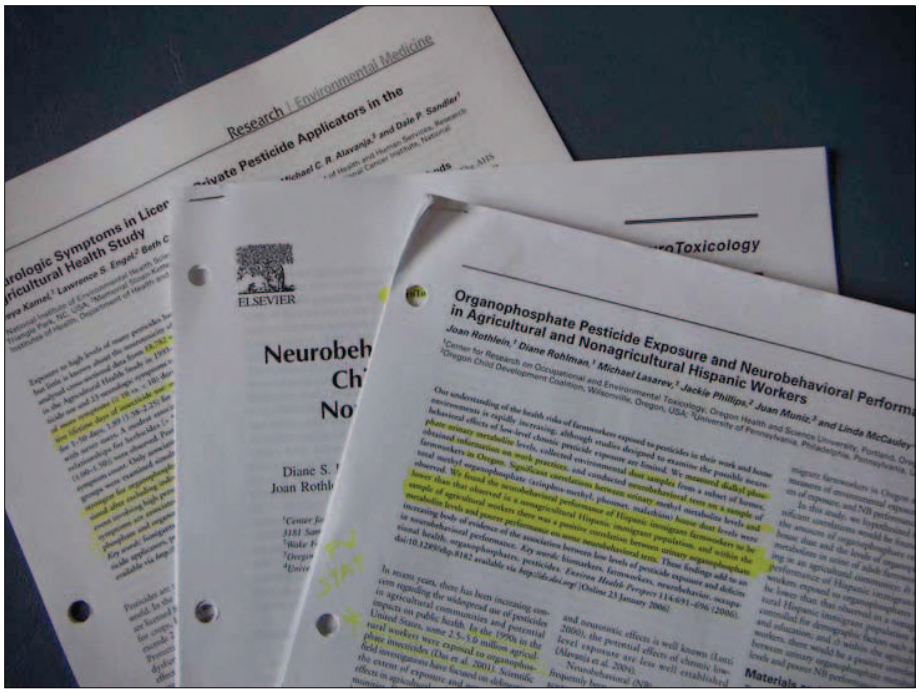
Concentrations below those deemed "acceptable" are not necessarily safe

Reference Exposure Levels for chlorpyrifos are based on only one mechanism by which chlorpyrifos may cause harm. The studies establishing the "No Observable Adverse Effect Level" from which these RELs are derived considered only effects associated with inhibition of the nervous system enzyme, cholinesterase. There is extensive and compelling scientific data showing that chlorpyrifos and other organophosphates injure people, especially developing babies, through other mechanisms as well.[20] In addition, exposures to many different OPs may add to the cumulative risk that individuals are experiencing. Thus, we need to be concerned not only about the days during which RELs were exceeded, but also about all the days on which children and adults were exposed to chlorpyrifos.

There is strong evidence that chlorpyrifos causes neurological injury

Scores of animal studies have now documented significant neurological changes in the developing fetus such as fewer brain cells, reduced brain weight, abnormalities in synaptic communication and other changes from organophosphate pesticide exposures, and in particular from chlorpyrifos exposures.[21] New *human* studies provide strong evidence that people are being adversely affected in agricultural communities as well. For example:

A study of children in Oregon and North Carolina found that children of farm workers "performed poorer on measures of response speed (Finger tapping) and latency (Match-to-Sample) compared to the Non-AG children. These results demonstrate modest differences in AG children compared to Non-AG children that are consistent with functional effects seen in adults exposed to low concentrations of organophosphate pesticides."[22]



Large numbers of studies provide evidence of neurological impacts and other health effects associated with exposures to chlorpyrifos and other organophosphates.

A study of adults in Oregon found "the neurobehavioral performance of Hispanic immigrant farmworkers to be lower than that observed in a nonagricultural Hispanic immigrant population, and within the sample of agricultural workers there was a positive correlation between urinary organophosphate metabolite levels and poorer performance on some neurobehavioral tests."[23]

An analysis of data from over 18,000 applicators in the Agricultural Health Study found a higher incidence of neurologic symptoms associated with cumulative lifetime days of insecticide use.[24] Among classes of insecticides, associations were strongest for organophosphates. Associations with cumulative exposure persisted after excluding individuals who had a history of pesticide poisoning or had experienced an event involving high personal pesticide exposure. These results suggest that self-reported neurologic symptoms are associated with cumulative exposures to moderate levels of organophosphates, even in the absence of an acute poisoning episode.

A Columbia researcher conducted epidemiological studies on pregnant mothers exposed to chlorpyrifos through involuntary home pesticide use. She demonstrated a link between *in utero* exposure to chlorpyrifos and low birth weights and/or reduced head circumference of newborns in the study, most significantly for mothers whose genetic makeup is such that they produce low levels of PON1, the enzyme that is responsible for detoxifying chlorpyrifos and its oxon in the body.[25]

Preliminary findings from a study in North Dakota indicate that children exposed to agricultural pesticides used near their homes have lower IQs compared to the children not experiencing those exposures. The pesticide-exposed children had lower full scale IQ in general, and also did more poorly than the less-exposed children in terms of scores on various neurobehavioral tests such as for verbal comprehension, perceptual reasoning, working memory and processing speed.[26]

In short, one would expect from the compelling animal studies done to date that people exposed to chlorpyrifos would experience injury to the nervous system. And human studies are indeed now finding those sorts of health impacts.

"Within the sample of agricultural workers there was a positive correlation between urinary organophosphate metabolite levels and poorer performance on some neurobehavioral tests"

Rothlein et al, "Organophosphate Pesticide Exposure and Neurobehavioral Performance in Agricultural and Nonagricultural Hispanic Workers," *Environmental Health Perspectives* 2006.

Protecting children… but not farm children

"Chlorpyrifos is part of a class of older, riskier pesticides, some going back 50 years. Exposure to these kinds of pesticides can cause neurological effects…. It is clear the time has come to take action to protect our children from exposure to this chemical."

EPA Director Carol Browner, June 8, 2000, while announcing a ban on chlorpyrifos in residential products and in products used at schools, daycares and other areas where children could be exposed...but not in agricultural areas where the children of farm workers and others live and go to school.

Injuries associated with chlorpyrifos are not limited to neurological damage

Chlorpyrifos exposure is also associated with health effects other than neurotoxicity. A major study of farmers and their families found an association between chlorpyrifos use and lung cancer.[27] And the Association of Occupational and Environmental Clinics (AOEC) lists all organophosphates generally and chlorpyrifos in particular as capable of causing asthma in previously unaffected individuals.[28] Exposures can also exacerbate asthmatic symptoms in individuals who already have the disease. Chlorpryifos is also a suspected hormone disrupting chemical; moderate doses have been shown to alter hormone levels in animal studies. [29]

A precautionary approach is warranted

No one knows the full breadth of impacts that chlorpyrifos and other drifting pesticides will have on the countless individuals inhaling them. Given multiple exposures and the variable ability of individuals to detoxify chemicals in the body, we may never know the full range of effects. The impact of an exposure in an unborn child, for example, will vary depending on the particular gestational day upon which exposure occurs. Individual vulnerability will also affect outcomes. In addition, people are exposed to an array of pesticides, not just chlorpyrifos, which can increase risks and can also limit researchers' abilities to establish definitive links between a particular pesticide and specific health outcomes. Both because of what we do know about the health impacts of chlorpyrifos and other pesticides, and because of what we do *not* know, we cannot allow exposures to continue for either children or adults.

V. Government's Response: Refusing to Look, Refusing to Act

Our air testing confirmed that children and adults in the northern Yakima Valley are inhaling chlorpyrifos at their homes at concentrations exceeding RELs on some days. There is substantial reason to anticipate that these exposures are interfering with neurological development and functioning of those exposed. People may also be at risk of other health effects such as lung cancer and asthma. Additionally, chlorpyrifos is only one of many pesticides to which people are exposed. Given state and federal statutes that are supposed to protect people's health, how can this situation exist?

Flying blind: Vital information is missing

Without data on pesticide use and airborne pesticide levels after routine applications, it is impossible for government agencies to carry out their mandates to protect health. They cannot ensure that existing regulations are enforced. Nor can they make informed decisions about new policies and programs. Similarly, denying basic information about pesticides to affected individuals restricts their ability to take action to prevent exposures, obtain accurate medical diagnoses and treatments, seek enforcement of existing regulations, and advocate new protections. State and federal governmental bodies have ignored requests to provide vital information about pesticides on three important fronts: air monitoring, pesticide use reporting, and notification.

EPA fails to take into account most inhalation exposures

The regulatory process for controlling the adverse effects of pesticides begins with risk assessment, the process by which EPA evaluates the toxicity of the pesticide and determines likely routes of exposure. For most pesticides, including chlorpyrifos, EPA assumes inhalation exposures are negligible and does not factor them into its risk assessment. Yet the data show that in areas of high chlorpyrifos use, inhalation is the primary source of exposure, dwarfing other sources of exposure like food and water.

California Air Resources Board (CARB) monitoring data[30] indicate that infants living 50 feet from an application site during the day the application takes place are exposed to a dose that is over 77 times the "acceptable" acute dose. Our data from the specific Yakima Valley sites in Washington State indicate that the highest exposure was four times the "acceptable" acute dose. These studies very clearly show that EPA is failing to protect public health when it assumes inhalation exposure is zero for rural residents in areas of high chlorpyrifos use.

Starting in 2002, PAN began to request EPA to evaluate and account for inhalation exposure in its risk assessments. At that time, EPA staff in charge of exposure assessment were not even aware of the 18 years worth of air monitoring data that had been collected in California. Since that time, EPA has not changed its process and continues to issue risk assessments for most pesticides without acknowledgment that inhalation is a major contributor to exposures in rural areas.

Refusing to monitor the air

Although much evidence points to the need for more air monitoring to determine the scope and magnitude of the problem of airborne pesticides, state and federal agencies have failed to establish an air monitoring program in Washington State.

FWPP began requesting Department of Agriculture (WSDA) leadership in establishing air monitoring in 2004 as a member of an agency workgroup formed in response to comments we and others had submitted in 2003 calling for action on drift. The agency refused to discuss the concept. In December of 2005, we sent a letter to WSDA reiterating our call for the agency's leadership in establishing a state air monitoring system directly or through other agencies. WSDA sent a short response indicating that our letter concerned "issues of air quality" and that "(t)he Department of Agriculture does not have statutory authority for air quality issues; this responsibility lies with the Department of Ecology." It offered no assistance in support of air monitoring although it is the state agency with lead authority regarding pesticide issues. Nor did it respond to FWPP's requests that WSDA's own inspectors be given air monitoring equipment to enable them to enforce drift regulations. FWPP also sought the Governor's support for air monitoring early in 2006, to no avail. Our attempts at gaining assistance from EPA in its role as overseer of the state's pesticide program have also failed.

Yet, we do not think this is an unreasonable request. Air monitoring is relatively inexpensive. The air monitors used by FWPP and PAN cost approximately $600 each. Laboratory costs can be minimized by using laboratories that already exist within state agencies. Based on the costs of air monitoring in California, a good initial air monitoring program could probably be established in Washington State for $500,000 or less. That price tag includes costs for method development for common pesticides used in the state, sample collection, laboratory analysis, and data evaluation by DOH. The air monitoring program could use monitors placed on schools and other buildings, as well in other locations. For an additional $3,000 the state could buy five Drift Catchers for use by inspectors charged with enforcing pesticide regulations.

Keeping pesticide use secret

California not only monitors the air, it also requires growers to report their pesticide use. As a result, people

can find out what has historically been applied near their jobs, homes and community buildings.[31] Access to this information helps people identify and investigate potential exposures, make connections to symptoms they may be experiencing, and obtain proper medical treatment.

Access to pesticide use data has enabled California researchers to analyze the relationship between application dates and ambient air concentrations as measured via air sampling. Pesticide use data can also be used in epidemiological studies to evaluate potential correlations between the incidence of diseases and injuries and nearby pesticide use.

In Washington State, however, the public's right to know about the pesticides that threaten our health is denied. Although pesticides regularly drift onto our bodies and into our homes, we are denied even basic information as to which pesticide has been applied.

Denying neighbors notice prior to applications

Currently, pesticide applicators are not required to provide notice to neighbors prior to pesticide applications, even for applications of the most drift-prone and most acutely toxic pesticides. In the absence of notice, people are less able to minimize their exposures by closing windows or leaving the area. Those who are exposed to drift are less likely to know about it and to be able to obtain accurate medical diagnoses and treatments. [32] They are less likely to be able to monitor applications and to seek enforcement actions against drift.

WSDA proposed a limited notice rule in 2005 and held four public hearings on it. The agency withdrew the rule on December 30, 2005, however, citing lack of consensus for it, and implying that support and opposition for the rule had been roughly even. However, based on a review of documents obtained under the state's Public Disclosure Act, the *Wenatchee World* reported that the agency received 277 comments in favor of the rule and 25 opposed. The *World* also disputed WSDA officials' accounts of results from a survey of schools the agency had conducted.

WSDA also cited potential liability for schools and other institutions as a reason to not give them notice of upcoming nearby pesticide applications.

FWPP, the parent of a child injured by pesticide drift, the state nursing home resident's ombudsman, representatives of the Washington Education Association, the United Farm Workers, the Washington Toxics Coalition and others urged Governor Gregoire to direct WSDA to reverse its decision and require notice to schools and other neighbors prior to pesticide application. The Governor has not done so. For a more detailed discussion of the proposed rule and its withdrawal, see Appendix 6.

In summary, state and federal governments have opted to keep people in the dark and to keep pesticide exposures and their impacts on individuals and communities invisible. They have failed to collect basic and much-needed data. They have made it impossible for those whose health is at stake to find out about nearby pesticide use in order to protect themselves.

Failing to enforce against drift

Under state law it is illegal for someone to handle agricultural pesticides in a manner that allows the pesticide to contact people not involved in the application, directly or through drift.[33] Our air monitoring results and other data indicate that this requirement is potentially being violated on a massive scale. The children and adults at the homes where monitoring was done lived in those homes during the monitoring projects. The children played in the yards. Clearly, chlorpyrifos came in contact with their bodies, through inhalation and potentially through their skin. At these two houses alone, an unborn child and 10 individuals were exposed. And the exposures documented at these homes are not likely to be anomalies. Just by living near agricultural lands, thousands upon thousands of individuals are being unwittingly exposed to chlorpyrifos and other pesticides, often at levels exceeding RELs. Nothing is being done to protect people from these exposures—not by WSDA, not by EPA, and not by other state or federal agencies..

Instead of stepping up enforcement, in recent years, state agencies have undermined public confidence in their ability to enforce against drift. For example:

• WSDA and the Washington State Department of Labor & Industries (L&I) have failed to provide air monitoring equipment to inspectors.

• Under pressure from some growers and their representatives, the WSDA removed one of its most effective inspectors who had sought to enforce drift regulations.[34] Although an independent investigation cleared the inspector of alleged wrongdoings, WSDA's Director Valoria Loveland refuses to return him to his position.

• Under pressure from the Farm Bureau and without notice to or input from farm workers and others, WSDA management weakened WSDA's policy regarding inspectors' rights of entry onto orchards and farms.[35]

• In a case involving six workers made ill by drift from an aerial application at a nearby orchard in 2002, WSDA Director Loveland denied a request from the Department's Pesticide Management Division to impose a fine and a license suspension on the pesticide applicator. An administrative law judge had inexplicably turned down the Department's request to impose the fine and license suspension despite the overwhelming evidence of the applicator's violation of state pesticide rules. Pesticide Management Division staff asked

Director Loveland to overturn the administrative law judge's decision, but she declined to do so. The drift victims turned to the courts following the Director's refusal to follow her staff's recommendations as to a fine and license suspension. The Thurston County Superior Court overturned Loveland's decision on December 9, 2005, finding that substantial evidence did not support it, an unusual position given the deference usually shown to agencies by the courts.[36] On October 24th, 2006, the Court of Appeals upheld the superior court's decision.[37] Unless the case is appealed to the state's Supreme Court, it will be remanded to Director Loveland who will decide what penalty should be imposed on the applicator.

EPA has failed to ensure adequate enforcement by the Washington State agencies to which it has delegated authority for implementing federal pesticide laws. Farm worker groups and others have pointed to WSDA's poor record on this front and to WSDA management's undercutting of the agency's inspectors to no avail. EPA has not used its oversight authority to demand changes that would protect workers, their families and others in agricultural areas from pesticide exposures.

Failing to adopt new protections

FWPP and others submitted written comments to the Washington State Department of Agriculture (WSDA) in the fall of 2003 calling for action on drift. The agency's primary response was to eventually form a stakeholder group to discuss aspects of drift issues. In FWPP's written comments and through the stakeholder group, we and others called upon WSDA to take action to prevent drift and protect health. In addition to seeking WSDA leadership in working with the Governor's office and other agencies to establish air monitoring, we sought various interim reforms such as:

1) No-spray buffer zones around unprotected workers, daycare centers, homes, and schools,

2) Prohibitions on applications when wind speeds exceed 5 miles per hour on average and when gusts exceed 10 miles per hour.[38]

3) Restrictions on the use of drift-prone application techniques such as airblast sprayers.

These measures were suggested as immediate interim measures to reduce exposures, but our top priority was the adoption of policies and programs to replace dangerous drift-prone pesticides with safer substitutes. We asked for phase-outs of chlorpyrifos and other dangerous pesticides and for meaningful support for programs and policies to assist growers making transitions to alternatives.

Noting that "(p)esticide drift is an important cause of pesticide-related illness in Washington", the 2004 PIRT report had called for consideration of these same sorts of measures.[39] Strategies for preventing drift mentioned in the report include the increased use of non-chemical pest management techniques, new technologies to reduce drift (air induction nozzles, "smart" sprayers and tunnel sprayers, for example), disincentives to applicators and farm managers who cause drift, and buffer zones.[40]

WSDA limited the scope of workgroup discussions, and did not engage in analysis of the reforms proposed by FWPP and others. Instead it proposed only a narrow notice rule which it ultimately withdrew as discussed above.

At the federal level, EPA released its final Cumulative Risk Assessment for Organophosphates on July 31st, 2005. As part of its announcement, it made the interim reauthorization for chlorpyrifos and many other organophosphates final, thereby authorizing their use for years to come. On November 16, 2006, EPA announced its re-registration decision for azinphos methyl (Guthion), another highly dangerous organophosphate used in large volumes in Yakima Valley and elsewhere. In 2001, EPA had authorized continued use of AZM on many crops including apples for four years, while openly acknowledging that workers would face health risks deemed unacceptable by the agency as a result. Then in 2006, instead of ending AZM use on these crops, EPA proposed extending the registration for *another* four years. Farm workers and others objected to the extension and called for an immediate ban. EPA's final decision extended AZM's registration for not just four years, but *six* years instead. Farm workers and others are currently evaluating the final decision and its details which include a 60 foot no-spray buffer zone requirement around certain occupied structures and outdoor recreational areas.

WSDA also has authority to phase out pesticides from use in Washington State, but rarely uses it. Farm workers succeeded in securing a ban on the pesticide phosdrin here in 1993, in advance of federal action on that pesticide. The agency has failed to use its authority to ban or phase out pesticides since that time.

In summary, federal and state agencies that are supposed to protect public health from pesticides have failed to use their authority to do that. At the state level, one factor may be an inherent conflict of interest at WSDA, the state agency that is primarily responsible for pesticide management in the state. WSDA is responsible for both promoting agriculture and regulating it. The *Wenatchee World* Editorial Board and others have noted that this dual responsibility is problematic. As the *World* Editorial Board noted in an editorial in June of 2005, "It may be time to consider spinning off the Department of Agriculture's law enforcement role to another agency."[41]

VI. A New Vision for Growing Food

Not far from Prosser in Washington State's lower Yakima Valley, the orchards and vineyards of Adolfo Alvarez provide an example of a different way of growing food. Mr. Alvarez's agricultural methods do not subject workers, their children and other neighbors to chlorpyrifos, other organophosphates or other dangerous pesticides. Nor do pesticide residues linger in the apples, cherries, and grapes that go forth from the farm to the market. Mr. Alvarez is one of a growing number of farmers who have chosen to forego the use of pesticides, using organic alternatives instead.

Mr. Alvarez and other organic farmers use pheromones to disrupt the mating of coddling moths. He and his workers inspect the crops regularly and use spot oil applications and other low-toxicity techniques to address pest outbreaks. He chooses carefully the ground covers that he will use and otherwise stays in tune with ecological systems and the interplay that affects pests, soil fertility, and crop production. The chemicals he applies have been certified as organic and do not pose the health risks associated with chemicals used in conventional agriculture.

Pheromone mating disruption (wire around branch) is used to control the coddling moth

Alternatives are already successfully used to grow food without exposing workers, their children and others to chlorpyrifos and other pesticides

It is difficult to determine the amount of resources currently allocated to promoting alternatives to chlorpyrifos and other agricultural pesticides in Washington State. However, most agree that the overall amount of resources going to sustainable agriculture are very limited, however. Expenditures on research into alternatives and outreach to growers are dwarfed by expenditures associated with promotion, management and regulation of conventional pesticides.

Little has been done to systematically identify the barriers that prevent more growers from switching to alternatives such as those used by Mr. Alvarez. Government officials have not shown leadership in establishing a public process for bringing farm workers, growers, and others together to identify policies and programs that can facilitate transitions to sustainable agriculture.

Mr. Alvarez works hard to grow food without pesticides. Current policies and programs that ignore the huge exposures and health costs associated with conventional pesticide use put him at an economic disadvantage. New policies and programs could instead support organic growers, reflecting the benefits they provide in terms of healthy workers, healthy neighbors, healthy foods, and healthy ecosystems.

A healthy farm economy is essential for producing food for millions to eat and for enhancing security by preventing excessive dependence on distant producers. By documenting pesticide health risks and seeking greater protections from drift, we are working to move Washington State towards a more sustainable farming system. We are concerned about the hardships growers face, particularly family farmers, and about the loss of agricultural lands to development. The livelihoods of farm workers depend upon a strong agricultural industry in Washington State. But we can and must have an agricultural system that does not poison its workers or those living nearby.

The solution to the economic challenges facing growers is not to ignore the exposures and health risks associated with reliance on highly toxic pesticides. Instead, we must join together both to better protect health and to make farms more sustainable. There are long-term economic benefits to growers associated with reducing reliance on conventional pesticides.[42] Our organizations look forward to discussions with growers and others to develop real solutions that end toxic exposures and protect farms by promoting sustainable agriculture.

VII. Recommendations

Farm worker community members and public interest organizations have helped shine a light on a matter that has been kept in the dark for too long. In the absence of government testing of pesticides in air, we have conducted air monitoring ourselves. Our findings document what we have long suspected: the air is not safe to breathe, particularly for our children. We call upon our government leaders to act immediately to protect us from further harm.

We call upon Governor Gregoire to:

1) Direct the Department of Agriculture, the Department of Ecology, the Department of Health, and the Department of Labor & Industries to establish an air monitoring program.

Specifically, they must require air monitoring for chlorpyrifos and other pesticides in agricultural areas and secure funding for this program in the upcoming legislative session. Monitors should be operated during times of high pesticide use, gathering comprehensive data regarding airborne pesticides at homes, daycares, schools, and workplaces. The Department of Health should be designated as the agency that analyzes and explains the testing results in the context of available data regarding health risks for children and adults.

2) Launch an Alternatives Assessment at the Center for Sustaining Agriculture and Natural Resources at Washington State University, and secure funding for this assessment in the upcoming legislative session.

This assessment should review the availability of safe alternatives for chlorpyrifos and the other pesticides most affecting farm workers, their families and others in agricultural areas. The assessment should identify areas in which additional research for alternatives is needed. It should also identify barriers that prevent growers from using alternatives, and provide steps that can be taken to remove those barriers and otherwise help growers make transitions to alternatives. Farm workers and other drift victims, as well as growers, must be actively involved in design and implementation of the assessment.

3) Establish a new direction at WSDA and/or support reorganization that removes public health protection responsibilities to a different agency more able to carry out those responsibilities.

4) Direct WSDA to immediately adopt an expanded notice rule providing prior written notice to workers, residents, daycare centers, nursing homes, schools, and all individuals within a specified distance prior to dangerous pesticide applications.

5) Direct WSDA and the Department of Labor & Industries to provide air monitoring equipment to inspectors and to develop and implement strategies for enforcement against drift.

6) Direct the Department of Health to take a more visible leadership role on the issue of exposures to agricultural pesticides and the need for new policies and enforcement to protect health. DOH should review and report upon new data on exposures and health effects, and the implications for policies and enforcement in the state. The agency should take health-protective positions on proposed rules and legislation related to agricultural pesticide issues, and it should propose rules and legislation to reduce and prevent exposures.

7) Greatly increase funding for sustainable agriculture programs to replace chlorpyrifos and other pesticides with safer ways of controlling pests.

8) Establish realistic yet rapid timelines for phasing out the most dangerous pesticides, including chlorpyrifos and azinphos-methyl.

We call upon the U.S. EPA:

1) Phase out chlorpyrifos and other organophosphates.

2) End the use of azinphos methyl immediately.

3) Greatly increase funding for and focus on developing and promoting sustainable agriculture and alternatives to pesticides.

4) Engage in meaningful oversight of states' implemention of federal pesticide laws. EPA should immediately initiate a review of WSDA's implementation of pesticide laws in Washington, and recent actions by the agency outlined in this report that undercut its ability to enforce laws and protect health. Strong enforcement must be a condition for continued delegation of pesticide enforcement authority to the state.

5) Account for near-field inhalation exposures when conducting risk assessments.

6) Establish air monitoring of agricultural pesticides directly and through delegated states. EPA should require air monitoring as part of each delegated state's implementation of pesticide laws. It should provide training and financial assistance to facilitate air monitoring.

We call upon the Washington State Legislature to:

1) Establish and fund air monitoring of agricultural pesticides.

2) Establish and fund the Alternatives Assessment process discussed above in Recommendation 2 to Governor Gregoire.

3) Greatly increase funding and staffing for developing and promoting alternatives to pesticides at state agencies and academic institutions.

4) Require Labor & Industries and WSDA to develop and implement a phase-out program for the most dangerous agricultural pesticides.

5) Support placement of public health protection authority regarding pesticides in an agency focused on public health protection.

We call upon grower organizations to:

Work with farm worker and community organizations towards policies and programs that will protect health and the long term viability of farming in Washington.

Appendix 1 Examples of Dust and Urine Studies Documenting Chlorpyrifos Contamination in Washington State

All of the following studies can be obtained for free on-line at the Environmental Health Perspectives (EHP) website (http://ehp.niehs.nih.gov/). Chlorpyrifos is abbreviated CPF.

Lead Author, Title	EHP Cite/Year	Selected Findings
Curl, "Evaluation of Take-Home Organophosphorous Pesticide Exposure among Agricultural Workers and Their Children"	110(12), A787-792, Dec. 2002	CPF in housedust in 41 (26%) of 156 farm worker homes, in 34 (18%) of 190 vehicles. DETP (a metabolite of CPF and certain other organophosphates) was found in the urine of 78 (37%) of 211 children, 103 (48%) of 213 adults.
Fenske, "Children's Exposure to Chlorpyrifos and Parathion in an Agricultural Community in Central Washington State."	110(5), 549-553 May 2002	CPF was measured in house dust of all 75 homes in the study. Highest in homes of applicators, followed by homes of field workers, followed by non-ag-worker homes. Higher concentrations for houses closest to farmland.TCP (CPF metabolite) was found in 24% of urine samples of children. (Laboratory limitations probably prevented detection in other children.) CPF was found on the hands of 11% of the applicator/fieldworker children.
Koch, "Temporal Association of Children's Pesticide Exposure and Agricultural Spraying: Report of a Longitudinal Biological Monitoring Study"	110(8), 829-833, August 2002	Organophosphate pesticide metabolite levels in children's urine rose during spray months. "This pattern is ...consistent with the general theory that children are exposed continuously to a low level of these pesticides through their diet and that this chronic exposure is punctuated by episodes of relatively higher exposure from additional sources and pathways, such as residential pesticide use. In this agricultural community, pesticide applications on crops appear to serve as multiple-point sources for those residing in the region, and exposures rise and fall accordingly." (At page 831-832.) (Note: levels of metabolites associated with chlorpyifos and chemically similar OPs rose in months generally associated with high chlorpyrifos use.)
Simcox, "Pesticides in Household Dust and Soil: Exposure Pathways for Children of Agricultural Families"	103(12), 1126-1134, Dec.1995	Although CPF had been sprayed 2-3 months before sampling, 47 (98%) of farmer/farmworker houses had CPF in dust (as compared to 9 (82%) of the houses without agricultural workers.) The mean concentration for CPF in agricultural families' homes far exceeded that in non-ag homes.

Appendix 2 Calculation of Reference Exposure Levels (RELs)

In order to compare observed concentrations of chlorpyrifos in air with concentrations likely to be associated with adverse effects, the US EPA inhalation No Observed Adverse Effect Levels (NOAELs) for acute and sub-chronic exposures to chlorpyrifos of 0.1 mg/kg-day (based on plasma and red blood cell cholinesterase inhibition)[43] were used to calculate Reference Exposure Levels (RELs) for a sensitive receptor, a one-year-old infant weighing 7.6 kg, breathing on average 4.5 m^3 of air per day.[44] This calculation takes into account the 10-fold intraspecies, 10-fold interspecies and 10-fold FQPA uncertainty factors used by US EPA for chlorpyrifos.

$$\text{REL (1-year-old)} = \frac{0.1\ \ mg/kg \bullet day}{10_{\text{intra-UF}} \times 10_{\text{inter-UF}} \times 10_{\text{FQPA}}} \times \frac{10^6\ \ ng/mg \times 7.6\ \ kg}{4.5\ \ m^3/day} = 170\ \ ng/m^3$$

The calculated concentration is the equivalent of a concentration in air below which no adverse effects on cholinesterase inhibition are anticipated by US EPA. Note, however, that the developmental neurotoxicity observed for chlorpyrifos[45] is not mediated by cholinesterase inhibition and may occur at lower doses.

In July of 2006, US EPA published the final draft of the Organophosphate Cumulative Risk Assessment. In this document, they indicated their intent to eliminate the FQPA uncertainty factor for chlorpyrifos. This is contradictory to EPA's own conclusion about the need for the FQPA factor in the IRED for chlorpyrifos: [46]

> "The FQPA 10X Safety Factor has been retained due to increased susceptibility and sensitivity to chlorpyrifos among neonates when compared with adults, and for the qualitative increased susceptibility occurring at the high dose in the developmental neurotoxicity (DNT) study (cholinesterase inhibition in dams versus structural effects on developing brain of the offspring). In addition, recent data in the literature suggest that the inhibition of cholinesterase may not be essential for adverse effects on brain development. Further uncertainty arises from the lack of an offspring No Observed Adverse Effect Level (NOAEL) in the DNT. In that study, structural alterations in brain development were the toxicity endpoint of concern and were seen at the lowest dose tested."

The CRA contains no justification for changing the the FQPA factor from 10 to one, especially given EPA's own justification for its retention in the IRED. The additional developmental neurotoxicity data that have been published since the IRED was released (see references 19-26) indicates that an FQPA uncertainty factor greater than 10 is called for in the case of chlorpyrifos.

In addition to developmental neurotoxicity effects observed, work by Furlong *et al.* demonstrated that activity of the PON1 enzyme responsible for detoxifying chlorpyrifos varied by a factor of 164 between the most robust adult and the most sensitive child in their study population.[47] This result indicates that even an FQPA factor of 10 together with an intraspecies uncertainty factor of 10 is not be sufficiently protective of infants.

California EPA's Office of Environmental Health Hazard Assessment has also made a strong case for using the FQPA factor of 10 for chlorpyrifos, citing the numerous developmental neurotoxicity studies.[48]

Appendix 3 Additional Data from Pesticide Incident Reporting and Tracking (PIRT) Reports

Examples of Chlorpyrifos Drift Cases Reported to the Washington State Department of Health

The first two numbers of the case number indicate the year the incident occurred. For example, case 040051 happened in 2004. (The 2005 cases will appear in an upcoming PIRT report that is not yet published.). These cases were taken from the DOH portions of PIRT reports. There may also be separate cases handled by other agencies.

030035 A 9 year old male and 67 year old female developed neurological, ocular and respiratory symptoms after their homes were drifted.

040051: A 51 year old female complained of symptoms that she associated with a spray drift from a neighbor's apple orchard. She could taste, smell and feel the spray.

040052: A 75 year old male and 67 year old female complained of mild illnesses after drift from an adjacent orchard application.

040054: A 44 year old male was drifted on by a neighbor's application to cherries. He felt the mist while playing with his dogs in the back yard and became symptomatic.

050066: A 76 year old male was drifted upon while he was working with animals in his yard. He developed gastrointestinal and neurological symptoms the same day.

050076: A 31 year old father, a 31 year old mother, and their 4 year old daughter and 7 month old son were drifted on by a spray applicator while driving in their automobile.

Pesticide incidents included in PIRT reports are almost certainly just the tip of the iceberg. Most pesticide cases may go unreported and are not reflected in the reports. Many factors contribute to this reality including:

Lack of pesticide use reporting and notice (there are no reporting requirements in Washington), leading to situations in which people sickened by pesticides have not been informed of their exposures, and don't make the connection. A Wenatchee middle school girl's pesticide-induced illness in 2001, that almost went unreported is illustrative of this problem. The then-middle school student, her parents, and her emergency room doctors had no idea that she had suffered organophosphate exposure from sitting on the grass at school. The only reason her case was eventually investigated by state officials was persistence on the part of her parents in trying to figure out the cause of their daughter's severe health effects. Symptoms included elevated heart rate, incoherency, weak muscles, and eyes rolling back in her head. (WSDA Case C12, 2001)

Fear of losing work or pay, language barriers, and other factors that prevent farm workers and their family members from reporting cases or visiting doctors (who are required to report all pesticide poisoning cases). Washington State Department of Health focus groups with farm workers found that three of four participants had been sickened by pesticides at work, but very few had reported those illnesses to a doctor.[49]

Failure of health care providers to diagnose pesticide-related illnesses. Most have very little training on this topic. Even if they have information on pesticide exposures, providers may not know about possible links to health effects.

Failure of health care providers to file reports of pesticide illnesses.[50]

Lack of inclusion in PIRT reports of subtle and/or delayed health effects such as learning disabilities, other neurological impacts, birth defects, respiratory disease, and cancer.

Appendix 4 Chlorpyrifos Use Data

The National Agricultural Statistics Service (NASS) database indicates substantial use of chlorpyrifos in Washington State (Table 1).[51]

Table 1: Use of Chlorpyrifos in Washington State (2005)

Crop	% treated acres	Total active ingredient applied, lb/year
Apples	58	186,700
Cherries	44	26,500
Pears	22	13,200

According to an EPA Fact Sheet published in 2002 to accompany the IRED for chlorpyrifos, approximately 10 million pounds of chlorpyrifos are applied annually in agricultural settings in the United States.[52] The data available on chlorpyrifos for apples, cherries and pears nationally is shown in Table 2. For these crops, Washington State has the highest use of chlorpyrifos in the nation.

Table 2: Use of Chlorpyrifos on Apples, Cherries and Pears in the U.S. (2003)

State/Area (Crop)	% treated acres	Total active ingredient applied, 1000 lb/year
APPLES		
California	12	6.0
Michigan	57	27.0
New York	32	14.0
North Carolina	46	6.0
Oregon	73	9.0
Pennsylvania	27	5.0
Washington	63	217.0
Subtotal Apples		**284**
CHERRIES		
California	1	-
Michigan	3	-
Oregon	64	18.0
Washington	57	31.0
Subtotal Cherries		**49.0**
PEARS		
California	12	3.0
Oregon	12	4.0
Washington	42	21.0
Subtotal Pears		**28.0**
Total (Apples, Cherries, Pears)		**361.0**

Table 3: Changes in Chlorpyrifos use in Washington State Over Time

	1991	1993	1995	1997	1999	2001	2003	2005
	Percentage acres treated							
Apples	65	85	80	91	65	68	63	55
Cherries	15	74	49	59	59	48	57	44
Pears	12	28	37	57	59	33	42	22
	Total active ingredient applied, 1000 lbs/yr							
Apples	234.6	276.6	268.5	360.2	250.9	234	217	186.7
Cherries	4	19.1	14	17.2	20.6	21.6	31	26.5
Pears	5.2	16.6	16.6	28.7	28.3	17.1	21	13.2

Appendix 5 Detailed Results

Cowiche, WA

Of the 21 samples collected (spikes and blanks excluded) between April 3rd and April 23rd in Cowiche, 100% were found to be above the limit of quantitation (LOQ) of 20 nanograms (ng) of chlorpyrifos per sample (equivalent to an air concentration of 7 ng/m^3 for a 24-hour sample at a 2 L/min flow rate and using a 2.65 mL solvent extraction volume). Thirty three percent of the samples were above the 24-hour acute and sub-chronic child REL of 170 ng/m^3, calculated from the US Environmental Protection Agency's inhalation No Observed Adverse Effect Level (NOAEL), as shown in Appendix 2. The highest concentration observed for a 24-hour period was 572 ng/m^3 (3.4 times the 24-hour acute child REL) on April 12th, 2006.

Tieton, WA

Of the 21 samples collected (spikes and blanks excluded) between April 1st and April 21st in Tieton, all were found to be above the limit of quantitation (LOQ) of 20 nanograms (ng) of chlorpyrifos per sample (equivalent to an air concentration of 7 ng/m^3 for a 24-hour sample at a 2 L/min flow rate and using a 2.65 mL solvent extraction volume). Thirty eight percent of the samples were above the 24-hour acute and sub-chronic child REL of 170 ng/m^3, calculated from the US Environmental Protection Agency's inhalation No Observed Adverse Effect Level (NOAEL), as shown in Appendix 2. The highest concentration observed for a 24-hour period was 475 ng/m^3 (2.8 times the 24-hour acute child REL) on April 13th.

Complete results are provided in Tables 4 and 5. No chlorpyrifos oxon was detected in any of the samples. No chlorpyrifos was detected in any of the rear beds of the XAD-2 resin tubes, indicating that there was no breakthrough of chlorpyrifos from the front resin bed to the rear, i.e. no overloading of the sampling tubes. Samples with concentrations above the MDL but below the LOQ were estimated at half the LOQ, according to standard procedures.[53]

Table 4: Chlorpyrifos Air Concentrations in Cowiche, WA, April 3–April 23, 2006

Sample Name	Start Date	Start Time	Total Time (min)	Total Volume (m^3)	Conc. (ng/m^3) PANNA	Conc. (ng/m^3) EMA	Comment
Ama	4/3/06	5:04 PM	1630	3.42	19	9	
Tiempo	4/4/06	8:55 PM	1420	3.09	54	60	
Vaca	4/5/06	8:59 PM	1407	3.08	20	15	
Arroz	4/6/06	8:49 PM	1328	2.84	203	180	
Musica	4/7/06	7:20 PM	1473	3.24	168	157	
Azucar	4/8/06	8:12 PM	1235	2.72	86	68	
Pan	4/9/06	5:02 PM	1375	2.94	140	79	
Yunta	4/10/06	4:14 PM	1678	3.67	145	114	
Una	4/11/06	8:27 PM	1443	3.21	338	187	
Hueso	4/12/06	8:45 PM	1404	2.93	462	681	
Primo	4/13/06	8:24 PM	1397	3.00	---	261	"A" tube broke.
Papel	4/14/06	7:58 PM	1392	3.08	320	192	
Mango	4/15/06	7:23 PM	1379	3.02	216	169	
Coche	4/16/06	6:39 PM	1456	3.19	228	187	
Futbol	4/17/06	7:15 PM	1488	3.20	140	117	
Lengua	4/18/06	8:23 PM	1128	2.48	133	93	
Bola	4/19/06	3:24 PM	1716	3.67	178	128	
Copa	4/20/06	8:13 PM	1207	2.66	179	122	
Rapido	4/21/06	4:33 PM	1359	2.92	32	33	
Santo	4/22/06	3:25 PM	1690	3.59	19	26	
Mejor	4/23/06	7:49 PM	1270	2.76	16	20	

Table 5: Chlorpyrifos Air Concentrations in Tieton, WA, April 1–April 21, 2006

Sample Name	Start Date	Start Time	Total Time (min)	Total Volume (m^3)	Conc. (ng/m^3)	Comment
Hombre	4/1/06	2:40 PM	1423	3.06	194	Duplicate. Average of 194 and 194 ng/m^3.
Zona	4/2/06	2:44 PM	1515	3.26	46	Duplicate. Average of 50 and 41 ng/m^3.
Puro	4/3/06	4:20 PM	1489	3.28	156	Duplicate. Average of 161 and 151 ng/m^3.
Pico	4/4/06	5:25 PM	1331	3.29	220	Duplicate. Average of 228 and 211 ng/m^3.
Oido	4/5/06	3:53 PM	1436	3.09	149	Duplicate. Average of 146 and 151 ng/m^3.
Ejido	4/6/06	4:09 PM	1526	3.24	55	Duplicate. Average of 51 and 59 ng/m^3.
Fuego	4/7/06	5:51 PM	1231	2.65	182	
Caldo	4/8/06	2:37 PM	1584	3.48	120	
Fin	4/9/06	5:15 PM	1336	2.87	100	
Rosa	4/10/06	3:41 PM	1426	3.14	403	
Linea	4/11/06	3:42 PM	1453	3.20	366	
Bolsa	4/12/06	4:08 PM	1434	3.08	156	Duplicate. Average of 307 and 4 (<LOQ value) ng/m^3.
Mujer	4/13/06	4:16 PM	1387	2.98	475	Duplicate. Average of 501 and 448 ng/m^3.
Codo	4/14/06	3:37 PM	1311	2.82	168	Duplicate. Average of 152 and 183 ng/m^3.
Lunes	4/15/06	1:39 PM	1329	2.92	184	Duplicate. Average of 185 and 182 ng/m^3.
Jugo	4/16/06	12:00 PM	1762	3.88	151	Duplicate. Average of 160 and 141 ng/m^3.
Tapa	4/17/06	5:35 PM	1501	3.23	129	Duplicate. Average of 116 and 142 ng/m^3.
Furia	4/18/06	6:45 PM	1268	2.76	164	Duplicate. Average of 174 and 154 ng/m^3.
Frase	4/19/06	4:08 PM	1467	3.15	143	Duplicate. Average of 126 and 160 ng/m^3.
Manga	4/20/06	4:47 PM	1162	2.53	195	Duplicate. Average of 195 and 194 ng/m^3.
Manta	4/21/06	12:21 PM	1685	3.71	55	Duplicate. Average of 52 and 58 ng/m^3.

Appendix 6 WSDA's Proposed Notice Rule

Notice would enable some individuals to take precautions to reduce exposures. If forewarned, some may be able to leave the area for a while. Others can close windows and vents, stay inside, and otherwise act to reduce risk. As the State PIRT Panel noted in its 2004 discussion of drift as a significant problem that needs to be addressed "Pre-notification of nearby residents would allow them to close windows and further minimize the effect of an accidental drift."[54]

WSDA proposed a weak rule in 2005 that would have required notice to a limited number of neighbors, such as daycares, on land adjoining application sites, for a limited number of pesticides. The rule was supported by the state Pesticide Incident Reporting and Tracking panel, farm workers, the state nursing home resident ombudsman, the Washington Education Association, the League of Women Voters, parents of children injured by pesticides, and many others, with most urging that it be expanded greatly and that more meaningful action be taken as well to prevent drift. *A Wenatchee World* review of written comments submitted to WSDA concluded that there were 277 comments in favor of and 25 opposed to the rule. The Farm Worker Pesticide Project had made a previous Public Disclosure Act request. Our review of all written comments found there to be: 290 submitted altogether, with 262 supporting the rule (50 individual comments, 212 form letters) as compared to approximately 21 opposing, and 7 comments we had difficulty classifying as pro or con.

After holding four public hearings and soliciting and receiving written comments, WSDA withdrew the rule on December 30, 2005. In a news release announcing the proposed rule withdrawal, WSDA said that a primary factor in its decision was that "the rule-making process developed no proposals that met with general agreement". Presented with FWPP's figures regarding actual numbers of comments received, WSDA Director Loveland, told reporters that the breakdown was closer to 50-50. In sharp contrast to FWPP's and the *Wenatchee World's* counts based on reviewing comments, WSDA indicated on February 12, 2006 that 41 comments had opposed the rule and 39 had supported it, with 21 more in favor if the rule was expanded. It excluded altogether from its tally hundreds of form letters it had received in support of the rule.

WSDA also indicated in its news release that it did not feel that organizations that would receive notice had played a large enough role in developing the proposed rule. It referred to "a follow-up phone survey to principals of 58 schools in the Yakima and Wenatchee areas which "did not produce any consensus about the value of the proposed rule." The *Wenatchee World* obtained the survey results and reported that WSDA had misrepresented the survey and its results. For example, only 33 of the institutions contacted had been schools, and 14 of the 17 schools that would have received notice under the rule, had supported it.

FWPP and others consider WSDA's position and statements regarding support for the proposed rule disturbing for a number of reasons. We conveyed to the Governor's office the following concerns:

First, the agency described support and opposition for the rule in a manner that was, at a minimum, very misleading. An independent party's (the *Wenatchee World's)* review of the actual comment record documented this as did our own review.

Second, the agency showed a propensity for devaluing the voices of those who call for more protections, such as by failing to include in its tally at all those who used form letters to express their support for the rule.

Third and most importantly, the agency made it clear that it will not adopt rules designed to protect health unless there is "consensus". It is apparent that growers and their representatives effectively hold a veto power over rules that are needed to protect health. It does not matter if workers, neighbors, parents, teachers, nursing home residents, and others are united in urging protection. Those who put others' health at risk by applying drift-prone highly toxic pesticides can prevent protections by simply opposing them.

In its news release announcing withdrawal of the proposed rule, WSDA gave a second rationale for its action: potential liability for schools and others that receive notice and then don't adequately pass on the information to others. Claiming to be incapable of providing guidance to schools and others about their legal responsibilities (although WSDA materials already existed listing various steps schools could take such as shutting vents), and ignoring the liability that schools and others may already have without notice, WSDA opted to withdraw the rule. The potential liability to which WSDA referred, stems from the fact that children and others can be severely injured or even killed by the highly toxic pesticides that were addressed in the notice rule. The Gregoire Administration decided to keep schools and others in the dark about upcoming pesticide applications, thereby reducing their ability to protect people, in order to limit their liability. FWPP and others protested this position arguing that preventing injury to children and others is of utmost importance.

Appendix 7 Sampling and Analysis Methods

Sampling and analysis methods were adapted from NIOSH method 5600 for organophosphorus insecticides[55] and the California Air Resources Board sampling and analysis protocols.[56] Samples were collected using a vacuum pump (Barnant, Cat. #400-1901) connected with 3/8" Teflon tubing and compression fittings to a manifold equipped with two Cajon-type, vacuum-tight Teflon fittings (Beco Mfg.) as sample tube holders. Flow controller valves tube allowed for adjustment of air flow to each tube independently. Pre-labeled sample tubes were attached to the manifold, approximately 1.5 meters off the ground. Flow rates were measured with a 0–5 L capacity rotameter (SKC Inc., Cat. #320-4A5) pre-calibrated with a mass flow meter (Aalborg, cat. #GFM17A-VADL2-A0A). The initial flow rate through each tube was set to 2.20 liters per minute. The flow rate was set at the beginning of the sampling run and then measured at the end to check for any changes. If the difference between the start and stop flow rates was less than 10%, these two values were averaged together to calculate an average flow rate. If the ending flow rate differed by >10% from the starting flow rate, the sample was discarded. Sample tubes were covered with mylar light shields during the sampling period to prevent photolytically catalyzed degradation of the sample. Sample identification, start and stop times, flow rates, wind speed and direction, temperature, weather conditions and any additional observations were noted on a Sample Log Sheet (SLS) at the beginning and end of each sampling period. At the end of each sampling period, labeled tubes were capped, placed in a zip-lock plastic bag with the completed SLS and transported on ice to a –10°C freezer. After storage for no more than two weeks, samples were shipped to the laboratory at –10 to 0°C by overnight express mail for analysis. A trip blank sample was included with each batch of samples during handling and transport. In the laboratory, samples were stored in a –20°C freezer prior to processing and analysis. Prior sample storage stability assessments conducted by the California Air Resources Board indicate that no degradation of chlorpyrifos on XAD-2 resin occurred during storage at –20°C for up to 37 days.[57] Samples were analyzed within this time period.

Sample tubes were extracted and analyzed according to NIOSH method 5600. Briefly, the front and rear XAD-2 resin beds were each extracted with either 2.65 mL of pesticide-grade ethyl acetate (PANNA lab) or 3.00 mL of 90:10 toluene:acetone (EMA Labs) using sonication, and the extracts were analyzed using a Varian 3800 gas chromatograph equipped with an electron capture detector (PANNA lab) or a gas chromatograph equipped with a nitrogen-phosphorus detector (EMA Labs). Peak identities were confirmed by mass spectrometry. Concentrated stock standards of chlorpyrifos and chlorpyifos oxon for use in analysis were obtained directly from Accustandard (Catalog numbers P-094S and P-700S respectively) and used to prepare dilute analytical standards. Lab spike recoveries were 106% (82–117%, N=10) for the PANNA lab and 65% (60–70%, N=2) for EMA labs. The difference in recoveries was likely due to the different solvents used in the extraction. Trip blanks and lab blanks were all free of chlorpyrifos or its oxon. The method detection limit (MDL) was determined according to standard procedures.[58] For air samples, the MDL takes into account the total amount of sampling time, the air flow rate through the sorbent tube, the volume of extraction solvent used to desorb the analyte, and the sensitivity of the instrument used to quantify the amount of analyte in a sample. For the samples analyzed in the PANNA lab, the MDL was 1.4 ng/m^3. The Limit of Quantitation (LOQ) was estimated at five times the MDL or 7 ng/m^3. The MDL for EMA Labs was 1.7 ng/m^3, with an LOQ of 9 ng/m^3. More details on the sampling and analysis methods can be found in the full report on the data at www.panna.org/campaigns/driftCatcherResults.html#FWPP.

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[1] S. Lee, R. McLaughlin, M. Harnly, *et al.,* Community exposures to airborne agricultural pesticides in California: Ranking of Inhalation Risks, *Env Health Persp*, 2002, 110: 1175–84.

[2] The PIRT Review Panel consists of representatives from six state agencies, the University of Washington, Washington State University, the Washington Poison Control Center, a toxicologist, and a member of the public. It was formed to ensure that state agencies responsible for pesticides regularly coordinate their incident investigations, reporting and education activities in a timely manner to protect workers and the public from pesticide misuse. (www.DOH.wa.gov/ehp/ts/PIRT/default.htm; November 12, 2006)

[3] Washington State Department of Health, *PIRT: 2005 Annual Report, Pesticide Incident Reporting and Tracking Review Panel,* December 2005, p. 54

[4] Direct spray cases are those in which contact with pesticides is caused by propulsion from the spray equipment rather than by wind.

[5] "Regularly" was defined as 50 or more hours per month in 2004 and 30 or more hours per month in 2005 and 2006.

[6] Scientific Advisory Committee (SAC) for Cholinesterase Monitoring formed under RCW 49.17.288, *Final Report. Cholinesterase Monitoring of Pesticide Handlers in Agriculture: 2004-2006. Report to the Washington Department of Labor & Industries,* November 13, 2006, p. 31. In 2006, 57 of 471 workers (12.10%) had significant (>20%) depressions. Under state regulations, employers are required to conduct workplace audits to determine causes of exposure when their workers experience cholinesterase declines of more than 20%.

[7] *Ibid,* Reference 6, page 40; Washington State Department of Labor & Industries, *Cholinesterase Monitoring of Pesticide Handlers in Agriculture: Report to the Legislature*, January 2006, at page 15; SAC, *Final Report. Cholinesterase Monitoring of Pesticide Handlers in Agriculture: 2004. Report to the Washington Department of Labor & Industries, March 30, 2005*, page 37 and 38. Data implicating chlorpyrifos includes: i) information on the pesticides workers with depressions handled, ii) the season during which most depressions occurred (i.e. times of high chlorpyrifos use), and iii) the type of blood test which revealed the majority of the depressions, i.e. the overwhelming majority of workers with depressions were identified via serum blood tests rather than red blood cell tests.

[8] *Ibid*, Reference 7.

[9] Washington State Department of Health, *PIRT: 2005 Annual Report*, *supra* at page 59

[10] National Agricultural Statistics Service (NASS) database, http://www.pestmanagement.info/nass/act_dsp_usage_multiple.cfm. Viewed on 8/22/06.

[11] United States Department of Agriculture, *Agricultural Chemical Use. 2005 Fruit Summary*, July 2006, pages 35, 71, and 171.

[12] 168 ng/m^3 was measured. The REL is 170 ng/m^3.

[13] 169 ng/m^3 was measured. The REL is 170 ng/m^3.

[14] Concentration averages were 161, 168 and 164 ng/m^3 on those days.

[15] See Appendix 1 for some examples.

[16] Lee, Reference 1.

[17] Dr. Alan Felsot used spray drift modeling to estimate that a no-spray buffer zone of 275 feet is needed near chlorpyrifos application sites to avoid exceedances of reference doses for children. His analysis was based on dermal absorption and did not examine inhalation. Nor did it factor in post-application volatilization drift. Factoring in inhalation exposure and post-application volatilization drift would result in larger buffer zones. Felsot, "Minimizing Pesticide Exposure in the Ag-Urban Interface," *WSU Agrichemical and Environmental News*, July 2003.

[18] *Report for the Application and Ambient Air Monitoring of Chlorpyrifos (and the Oxon Analogue) in Tulare County during Spring/Summer 1996,* California Air Resources Board, Test Report #C96-040 and # C96-041, April 7, 1998, http://www.cdpr.ca.gov/docs/empm/pubs/tac/chlrpfs.htm.

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[20] See for example:

a) Meyer et al, 2003. Developmental Effects of Chlorpyrifos Extend Beyond Neurotoxicity: Critical Periods for Immediate and Delayed-Onset Effects on Cardiac and Hepatic Cell Signaling, *Env Health Persp* 112: 170-178.

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f) Aldridge, JE, Meyer, A, Seidler, FJ, Slotkin, TA, Alterations in Central Nervous System Serotonergic and Dopaminergic Synaptic Activity in Adulthood after Prenatal or Neonatal Chlorpyrifos Exposure, *Env Health Persp*. 2005, 113(8): 1027-31.

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h) Colborn, Theo. 2005. A Case for Revisiting the Safety of Pesticides: A Closer Look at Neurodevelopment, *Env Health Persp* 114: 10-17.

[21] See Reference 20 for examples.

[22] Rohlman et al, Neurobehavioral Performance in Preschool Children from Agricultural and Non-Agricultural Communities in Oregon and North Carolina, *Neurotoxicology* (2005), 26:589-598.

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[31] California's Pesticide Use Report (PUR) is typically issued in the fall or winter the year after the reporting year, so aggregated data are not available in real time, but the reports are filed with the County Agricultural Commissioner within a week of the application for agricultural applications. See http://www.cdpr.ca.gov/docs/pur/purmain.htm for past pesticide use reports.

[32] A middle school exposed to Guthion on her school grounds in Wenatchee, Washington in 2001 suffered life-threatening symptoms, yet her emergency room doctors and her parents had no idea that pesticides were potentially involved. Notice in that case would have facilitated more informed health care and more prompt investigation of the school grounds. (Case documents for WSDA Case C12, 2001; discussions with the mother of the child involved in the case)

[33] Washington Administrative Code (WAC) 16-233-210(1); WAC 296-307-13010(1).

[34] See *Wenatchee World*, New pesticide cop's arrival marked increase in penalties, May 23, 2005; and *Wenatchee World* editorial, One agency, incombatible, June 19, 2005.

[35] The new policy was signed on April 7, 2004. Farm workers and others learned about it when WSDA announced that it had made the changes at a Pesticide Advisory Board meeting on April 20th. The Board unanimously adopted a resolution asking the Chair to send a letter to WSDA expressing concern about the agency adopting the policy without requesting input from the Board.

[36] Superior Court of the State of Washington in and for the County of Thurston, No. 04-2-02087-2, Order Reversing Administrative Decision, Mendoz et al vs. WSDA and Bender; Dec. 9, 2005

[37] Unpublished Opinion, Court of Appeals Division II, State of Washington, Docket Number: 34262-6; Oct. 24, 2006

[38] The National Coalition for Drift Minimization states in its video *Straight Talk About Minimizing Spray Drift: A Guide for Applicators* that the guidelines for maximum wind speed "are straightforward". "Generally when average wind speeds are above 5 miles per hour or gusting

above 10 miles per hour, crop protection products should not be applied near sensitive crops, water or people." The Coalition is composed of manufacturers, applicators, regulators and others. It does not include farm workers or their representatives, environmental organizations, etc.

[39] The report stated that "(s)trategies for preventing drift may include increased use of no-pesticide pest management…., new technologies that reduce drift…., education of pesticide applicators and farm managers about best management practices, and disincentives to applicators and farm managers who cause drift." The report stated that "(m)ore attention is needed to protect residences near agricultural fields. Use of buffers and vegetated strips may help prevent drift from reaching neighboring residences. Adoption of nozzle and sprayer technology could reduce protection of driftable particles." Washington State Department of Health, *2004 Annual Report, Pesticide Incident Reporting and Tracking (PIRT) Review Panel,* December 2004 at p. 43.

[40] Washington State Dept. of Health, *PIRT 2004 Report*, ibid. Reference 39, p. 43.

[41] "One agency, incombatible," *Wenatchee World* Editorial, June 19, 2005.

[42] For example, a study published in 2001 compared organic, integrated and conventional apple orchards in Washington State. All three had similar apple yields, but the organic and integrated systems had higher soil quality and potentially lower negative environmental impacts than the conventional system. The organic system produced sweeter and less tart apples, higher profitability and greater energy efficiency. The authors stated that their data indicate "that the organic system ranked first in environmental and economic sustainability, the integrated system second and the conventional system last." Reganold et al, Sustainability of three apple production systems, Nature 410, April 19, 2001, p. 926-930. (Integrated systems use both organic and conventional pest control methods.)

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[47] Furlong, CE, N Holland, RJ Richter, A Bradman, A Ho and B Eskenazi. 2006. PON1 status of farm worker mothers and children as a predictor of organophosphate sensitivity. *Pharmacogenetics and Genomics* 16:183–190.

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[49] Washington State Department of Health, Learning from Listening: Results of Yakima Farmworker Focus Groups About Pesticides and Health Care, June 17, 2004, revised on June 21, 2004.

[50] Washington State Department of Health, *Improving Data Quality in Pesticide Illness Surveillance*, June 17, 2004, revised June 21, 2004. See especially p. 12. Analysis showed that for medical records reviewed the pesticide incident surveillance system captured 60% of the eligible cases among agricultural workers.

[51] National Agricultural Statistics Service (NASS) database on 8/22/06, US Department of Agriculture, http://www.pestmanagement.info/nass/act_dsp_usage_multiple.cfm.

[52] Ibid, Reference 43 (US EPA, Chlorpyrifos IRED).

[53] Ibid, Reference 18 (CARB, Chlorpyrifos monitoring).

[54] Washington State Department of Health, *PIRT 2004 Report.*

[55] *NIOSH Method 5600: Organophosphorus Pesticides,* NIOSH Manual of Analytical Methods, U.S. National Institute for Occupational Safety and Health, http://www.cdc.gov/niosh/nmam/.

[56] Ibid, Reference 18 (CARB, Chlorpyrifos monitoring).

[57] Ibid, Reference 18 (CARB, Chlorpyrifos monitoring).

[58] Code of Federal Regulations 40, §136, Appendix B.

El Proyecto de Campesinos y Pesticidas

Farm Worker Pesticide Project is a nonprofit organization directed by farm worker community members. Together with the community, we gather and disseminate information on agricultural pesticide issues, help the community and allies unite behind a proactive strategy for better protecting people from pesticides, and act as an advocate, organizer, educator and researcher in helping to implement that strategy.

Farm Worker Pesticide Project has offices in Seattle and Yakima: NB 3, 5031 University Way, NE, Seattle, WA 98105; 206-729-0498; 3601 W. Washington Ave., Suite 10A, Yakima, WA 98903; 509-575-3934. www.fwpp.org

Pesticide Action Network North America advocates adoption of ecologically-sound pest management in place of pesticide use. Over 25 years, we've helped build an international network of more than 700 citizens groups in some 100 countries into a global citizen movement. PAN has regional coordinating centers in Africa, Asia, Europe, Latin America and North America. PAN North America links the collective strengths and expertise of groups in Canada, Mexico and the U.S. with counterpart citizen movements in other countries. We promote environmental health, sustainable agriculture, workers' rights, food security and social justice. PAN's office is located at 49 Powell Street, Suite 500, San Francisco, CA 94102; 415-981-1771; www.panna.org

PAN also maintains the world's most comprehensive database available on the web for information on pesticide toxicity, registration status, poisoning symptoms and many other factors. See www.pesticideinfo.org

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