



# **Cholinesterase Monitoring of Pesticide Handlers in Agriculture: 2011 Report**

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**Division of Occupational Safety and Health (DOSH)**

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## Executive Summary

The Washington State Department of Labor & Industries (L&I), Division of Occupational Safety and Health (DOSH), administers the agriculture cholinesterase monitoring program under WAC 296-307-148<sup>1</sup>. During the 2011 cholinesterase monitoring season (January 17 – September 15), approximately ~388 growing operations and 2,017 pesticide handlers participated in pre-exposure baseline red blood cell (RBC) and serum cholinesterase testing. Of these handlers, 186 were tested again after handling class I or II organophosphate or N-methyl-carbamate cholinesterase inhibiting pesticides for 30 or more hours in any continuous 30-day period (periodic testing).

Six handlers (3.2%) experienced a cholinesterase activity depression of >20% (action level) requiring the employer to evaluate their pesticide handling practices. There were no cholinesterase depressions requiring temporary removal from handling (an RBC depression of  $\geq 30\%$  or serum depression of  $\geq 40\%$ ), and no pesticide illnesses reported.

While the number of handlers establishing baselines remains fairly stable, the number of handlers undergoing periodic testing decreased from 257 in 2010 to the 186 in 2011. Yearly testing numbers are believed to be affected by factors including, but not limited to:

- Pest control strategies.
- Pest pressures.
- Employer actions resulting in limiting handler exposure (e.g., employee rotation).

Conversations with growers and medical providers indicate that the weather had a significant impact on pesticide use and application windows in 2011, which in part may also explain the decrease in the number of handlers undergoing periodic testing.

DOSH policy<sup>2</sup> regarding response to action level cholinesterase depressions was updated in 2011 to address circumstances that indicate ongoing or significant deficiencies in an employer's pesticide worker protection program. In those cases, DOSH has shifted from a primarily consultation approach, in which the result would be a letter with recommendations for improvement, to now also include to include an enforcement approach which can result in a citation and financial penalties for the employer.

All handlers with cholinesterase depression that reached the action level worked in the tree fruit industry in L&I Region 5<sup>3</sup>. DOSH field evaluations of action level cholinesterase depressions continue to identify Pesticide Worker Protection Standard violations that may contribute to over-exposure including, but not limited to:

- Training.
- Respiratory protection.
- Personal protective equipment.

The cholinesterase inhibiting pesticides handled within the 30 days prior to periodic testing of those handlers with action level cholinesterase depression were Chlorpyrifos, Azinphos-methyl, and Carbaryl, a class III pesticide.

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<sup>1</sup> <http://www.lni.wa.gov/WISHA/Rules/agriculture/HTML/part-j-1.htm>

<sup>2</sup> <http://www.lni.wa.gov/Safety/Rules/Policies/PDFs/WRD3327.pdf>

<sup>3</sup> <http://www.lni.wa.gov/Main/FindAJob/regions.asp?WT.svl=3#3>

<sup>4</sup> Previous reports can be found at <http://www.lni.wa.gov/Safety/Topics/AtoZ/Cholinesterase/default.asp>

Pathology Associates Medical Laboratories (PAML) continues to conduct all laboratory analysis. Quality control indicators were well within limits and medical provider satisfaction remains high. PAML will continue to serve as the sole laboratory approved by DOSH in 2012.

In conclusion, the 2011 cholinesterase monitoring program functioned as designed. It continues to prove its value by maintaining awareness in the agriculture industry of hazardous chemicals and the need for worker protections, while at the same time bolstering DOSH's ability to work directly with agriculture employers to solidify protection programs for workers handling pesticides.

## Background

Acetylcholinesterase (AChE) is an enzyme that removes the chemical neurotransmitter acetylcholine from the junctions between nerves cells. AChE effectively serves as the nerve cell "off switch" and is essential to normal nervous system function. Organophosphate and N-methyl-carbamate pesticides bind with and inactivate AChE (cholinesterase depression). The result may be over-excitement and the eventual exhaustion of nervous system pathways and end points.

Depressed cholinesterase (ChE) activity may lead to physical symptoms ranging from malaise, blurred vision, and diarrhea. In extreme cases it can also result in coma and death. Laboratory monitoring of cholinesterase levels in the blood (both red blood cell [RBC] and serum cholinesterase) indicates overexposure to ChE-inhibiting pesticides and forecast a reduction in nervous system AChE activity before the onset of pesticide illness.

While cholinesterase levels may be affected by such factors as liver and blood disease, and certain medications, in the absence of such factors ChE depression in pesticide handlers is most likely caused by over-exposure to ChE inhibiting pesticides. Previous DOSH reports provide detailed background and describe cholinesterase monitoring experiences during the years 2004 – 10<sup>4</sup>.

The Cholinesterase Monitoring rule ( WAC 296-307-148), was adopted in December 2003. There were some amendments to the rule in 2005, but it has remained unchanged since then. The rule requires agriculture employers to:

- Record hours employees handle<sup>5</sup> toxicity class I and II organophosphate and N-methyl-carbamate pesticides (covered pesticides).
- Provide cholinesterase blood testing to employees who handle these covered pesticides for 30 or more hours in any consecutive 30-day period.
- Follow health care provider recommendations regarding pesticide handling practices and medical evaluation.

A copy of the licensed health care provider's (LHCP) written recommendation is provided to the handler by the employer. These recommendations include verification of testing, actions to be taken based on cholinesterase activity, and any recommendations regarding further medical evaluation.

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<sup>4</sup> Previous reports can be found at <http://www.lni.wa.gov/Safety/Topics/AtoZ/Cholinesterase/default.asp>

<sup>5</sup> Pesticide handling is defined in WAC 296-307-11005

Standardization of laboratory cholinesterase assay procedures is essential in establishing a comparative medical surveillance program. Medical surveillance standardization issues are addressed by requiring that all testing under the rule is conducted by Pathology Associates Medical Laboratories (PAML). Testing is conducted using the Ellman method and is monitored using ongoing internal and external quality control measures.

DOSH continues to reimburse employers for testing services and related administrative program costs<sup>6</sup>. Thirty eight employers requested and were granted reimbursements totaling \$75,180.

The following table outlines participation and monitoring outcomes from the use of PAML as the sole certified laboratory in 2007.\*

	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
<b># Growing operations**</b>	226	218	217	315	388
<b># Handlers submitting baseline tests</b>	1857	2013	2056	1989	2017
<b># Handlers declining testing</b>	167	192	229	Data not collected	Data not collected
<b># Working baselines</b>	120	71	29	51	43
<b># Handlers with <math>\geq 1</math> periodic test</b>	386	314	249	257	186
<b># Periodic tests</b>	532	495	286	316	202
<b># Handlers with ChE depression to work evaluation level</b>	49(12.6%)	21(6.7%)	15(6.1%)	8(3.1%)	6(3.2%)
<b># Handlers with ChE depression to exposure removal level</b>	18(4.6%)	1(0.1%)	7(2.8%)	0	0
<b>Total # handlers with AL ChE depression</b>	67(17.3%)	22(7.0%)	22(8.8%)	8(3.1%)	6(3.2%)***
<b># Handlers with reported pesticide illness</b>	0	0	0	0	0

\* Participation and outcomes during the years that testing was conducted through the Washington State Department of Health (2004-06) is included in prior reports.

<http://www.lni.wa.gov/Safety/Topics/AtoZ/Cholinesterase/default.asp>

\*\*A growing operation is defined as a specific site or orchard. An employer may have multiple growing operations.

\*\*\* Four (4) Serum and two (2) RBC cholinesterase depressions.

<sup>6</sup> The Cholinesterase Monitoring reimbursement request form can be found at <http://www.lni.wa.gov/forms/pdf/413062af.pdf>

## Medical Services

Eighteen medical clinics provided blood collection and medical evaluation services. Fifteen clinics are located in Region 5, two in Region 1, and one in Region 4<sup>7</sup>. In preparation for the 2011 monitoring season, the DOSH Occupational Nurse Consultant contacted all participating clinics. The nurse reviewed the rule and answered questions regarding the cholinesterase medical monitoring guidelines<sup>8</sup>.

Pathology Associates Medical Laboratories (PAML) in Spokane is the sole laboratory approved to provide testing services. There were no changes in the Standard Operating Procedures<sup>9</sup> established in 2009. Assay validation is conducted each year prior to handler testing. Blood samples (RBC and serum, along with a separate hematocrit sample) are placed in cold storage and picked up at the clinic using same-day courier services. Samples are analyzed within 24 hours of collection, using an Olympus 5420 analyzer, and reported to the medical clinic and DOSH that same day.

PAML is required to provide evidence of a robust quality assurance program including but not limited to:

- Maintaining a written quality assurance plan.
- Participation in the College of American Pathologists serum cholinesterase proficiency testing program.
- Allowing independent review of quality assurance data.
- Demonstration of proficiency through analysis of blinded samples.

The DOSH industrial hygiene laboratory regularly reviews PAML quality control reports and conducts onsite visits. All quality control indicators demonstrated good precision throughout the season.

Dr. Barry Wilson's Laboratory at the University of California, Davis provided independent consultation and oversight services. Dr. Wilson's laboratory also provides a bovine-based RBC quality control product used by PAML.

PAML continues to provide efficient testing services with all participating medical clinics reporting satisfaction. A glitch did occur when, for several days, Roche Diagnostics was unable to provide the cholinesterase test reagent used by PAML. Roche is the only supplier of this reagent. This resulted in the need to collect repeat samples for six handlers.

## Monitoring Summary

As in previous years, the vast majority of employers participating in the cholinesterase monitoring program had operations located in Central Washington including West Adams, Benton, Chelan, Columbia, Douglas, Franklin, Grant, Kittitas, Okanogan, Walla Walla, and Yakima counties. North and Southwest Washington counties accounted for a small number of laboratory samples submitted.

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<sup>7</sup> <http://www.lni.wa.gov/Main/FindAJob/regions.asp?WT.svl=3>

<sup>8</sup> <http://www.lni.wa.gov/Safety/Topics/AtoZ/Cholinesterase/files/ProvidersGuidelines1.pdf>

<sup>9</sup> Available upon request

During the 2011 cholinesterase monitoring season (January 17 – September 15), ~388 growing operations participated in testing and 2,017 handlers submitted cholinesterase baseline samples. Baseline submissions increased slightly from 2010, when 1,989 handlers submitted samples.

Of the 186 pesticide handlers who received at least one periodic (post-exposure) test, six (3.2%) received a periodic test result with a >20 percent cholinesterase activity depression from baseline (action level cholinesterase depression) requiring the employer to evaluate handling practices for possible deficiencies.

None of the 186 handlers experienced cholinesterase depression levels requiring temporary removal from handling organophosphate and N-methyl-carbamate pesticides (an RBC depression of  $\geq 30\%$  or serum depression of  $\geq 40\%$ ). The six handlers (four serum and two RBC action level ChE depressions) worked for five different growing operations. One of the handlers had experienced an action level cholinesterase depression in a previous year. No handlers were identified with pesticide illness related symptoms.

Handler receipt of the recommendations written by health care providers has been an ongoing concern. Of the six handlers with action level cholinesterase depressions, DOSH found that five had not received a copy of the health care provider's written recommendation at the time of the field evaluation. In one of these cases involving two handlers, the employer maintained that it had not been notified by the clinic. However, the clinic stated that it had left a voice mail for the employer and faxed a copy of the written recommendation.

Of the six handlers with action level cholinesterase depression, three had previously taken Washington State Department of Agriculture (WSDA) pesticide "hands on" pesticide training.

## **L&I Consultation and Compliance Findings**

All five of the growing operations with handlers who had experienced action level cholinesterase depression received site visits from DOSH. Two of the operations were visited by L&I consultants and three received enforcement visits due to multiple handler action level ChE depressions or having a handler(s) experience an action level ChE depression within the previous three years.

### **Consultation Inspection Summaries**

#### Growing Operation A

The consultation was initiated in response to a handler identified with a 24.87% serum ChE depression.

The handler attended WSDA "hands on" pesticide training in 2010.

During this time period the handler applied Lorsban 4E (Chlorpyrifos), a category II organophosphate pesticide, using the airblast method. Total hours of handling Lorsban 4E for the 30 days prior to testing was 49, and 49 for the year total.

The handler wears full protective clothing, a half-face respirator with OV cartridges and pre-filter, and safety glasses while applying.

No specific exposure incident was identified. Exposure may have occurred through the use of half-face respirators leaving portions of the face and neck open to skin exposure during airblast applications

Violations:

WAC 296-307-13045(1) Safety glasses were provided for use while applying Lorsban 4E. The label specifies the use of chemical resistant eye protection.

WAC 296-307-030(2) The Accident Prevention Program is not effective in practice. It was dated 1999 and some parts of it referenced the old Agriculture Standard, 296-306. It did not appear to have been updated or reviewed in nearly a decade.

WAC 296-307-59605 The employer did not have a competent person designated as the respiratory protection program manager.

WAC 296-307-55010 Employer did not maintain a current list of all hazardous chemicals present at the workplace.

WAC 296-307-03930 One of the mixing/loading sites had the emergency shower located approximately 121 feet from the point of the loading activity.

WAC 296-307-036(4) The Central Notification Board contained the required posters in English only. The majority of the employees speak Spanish and have limited or no education in English.

WAC 296-307-14815 The employer did not provide a written copy of the Licensed Health Care Professional's written recommendation for the baseline or monitoring test which disclosed a cholinesterase inhibition, within 5 days of receipt to the handler employee. It was determined the employer had not received the written reports from the licensed health care professional.

### Growing Operation B

The consultation was initiated in response to a handler identified with a 22.43% RBC ChE depression.

The handler is not a licensed applicator and had not attended WSDA "hands on" pesticide training.

During this time period the handler applied Guthion (Azinophos-Methyl) and Govern 4E (Chlorpyrifos), category I and II organophosphate pesticides respectively, using the airblast method. Total hours of handling Guthion and Govern 4E for the 30 days prior to testing was 41, and 80 for the year total.

The handler stated that on two occasions during this time period a cartridge fell off of his respirator while applying a category III N-methyl-carbamate pesticide.

Violations:

WAC 296-307-60005(1) The current Respiratory Protection Program is outdated and incomplete. It lacked compliance with all required elements in table 3.

WAC 296-307-59605 The employer did not have a competent person designated as the respiratory protection program manager.

WAC 296-307-60805 The handler had not received training on respirator decontamination and maintenance.

WAC 296-307-13045(6)(g) The respiratory protection program allowed use of organic-vapor (OV) cartridges could be used for 16 hours before changing out.

WAC 296-307-13045(1) Appropriate respirator pre-filters were not provided for Govern 4 E and Azinphos- Methyl 50W as required by the product labels

WAC 296-307-13045(3)(h) Chemical resistant aprons were not provided for mixing/loading and applying Govern 4E and Azinphos- Methyl 50W as required by the product labels.

WAC 296-307-14815 The employer did not ensure that an employee, who was tested and found to have a cholinesterase depression, was provided a copy of the LHCP written recommendation within 5-business days after the employer received the recommendation. And the employee did not receive any information on cholinesterase from the LHCP when reporting in for the Baseline Exam.

**Compliance Inspection Summaries**Growing Operation C

The inspection was initiated in response to a handler identified with a 23.10% serum ChE depression. The growing operation had handlers with action level ChE depressions in 2008 and 2009 with consultation services provided.

The handler wears full protective clothing, a half-face respirator with OV cartridges and pre-filter, and chemical goggles while mixing and loading. He stated that when working shifts of 8 hours and longer that during his downtime at the mixing area he would remove his respirator, letting it hang around his neck, and rinse his face with water to cool off. When the tractors return he dons the respirator, and continues to mix and load pesticide tanks. He stated that he does not smoke or eat during downtimes.

This handler completed WSDA “hands on” pesticide training in 2010.

During this time period the handler was mixing and loading Lorsban Advance (Chlorpyrifos), a category II organophosphate. It takes 10-15 minutes to load a tank and anywhere between 10-30 minutes downtime between loads. Total hours of handling Lorsban Advance for the 30 days prior to testing was 42, and 42 for the year total.

Since this incident, the employer has retrained all of the pesticide applicators on how to properly decontaminate themselves prior to removing PPE and respirators and how to protect themselves when mixing/applying chemicals in the orchards.

Violations:

WAC 296-307-13015(1) The employer was not posting pesticide spray application information in a central location where handlers can readily see the posting.

WAC 296-307-13015(2)(b) The employer was not posting pesticide spray application information before the application took place.

WAC 296-307-13015(2)(c) The employer was not posting pesticide spray application information for 30-days past the restricted-entry interval (REI).

WAC 296-307-14505(1) The employer's pesticide application records for 2011 did not include the address/exact location where the pesticide was applied, and the licensed applicators address and telephone number.

WAC 296-307-14815 The employer did not ensure that an employee, who was tested and found to have a cholinesterase depression, was provided a copy of the LHCP written recommendation within 5-business days after the employer received the recommendation. The employer had received the results from the LHCP but they were not provided to the employee.

Growing Operation D

The inspection was initiated in response to two handlers identified with 26.51 (handler A) and 20.50% (handler B) serum ChE depressions respectively.

The handlers wear full protective clothing, a half-face respirator with OV cartridges and pre-filter, and chemical goggles while applying. Handling procedures, PPE removal, and decontamination procedures were evaluated to be appropriate. Both handlers apply pesticides using the air blast method.

One of the handlers is a licensed pesticide applicator the other handler received WSDA "hands on" pesticide training in 2011.

During this time period, the handlers had applied Sevin (Carbaryl), a category III N-methyl-carbamate. Total hours of handling Sevin for the 30 days prior to testing was 74 for handler A and 76 for handler B, and 74 and 76 respectively for the year total.

No specific exposure incidents were identified. Exposure may have occurred through the use of half-face respirators leaving portions of the face and neck open to skin exposure during airblast applications, and one of the handlers wears a baseball cap under his hood.

Violations:

WAC 296-307-14815 The employer did not ensure that an employee, who was tested and found to have a cholinesterase depression, was provided a copy of the LHCP written recommendation within 5-business days after the employer received the recommendation. The employer stated

that they had not received the licensed health care professional's written recommendation. Records show that the clinic faxed the recommendation to the employer 4 days earlier.

### Growing Operation E

The inspection was initiated in response to a handler identified with 25.50% RBC ChE depression. The growing operation had three handlers with action level ChE depression in 2008 with consultations services provided.

The handlers wear full protective clothing, a full-face respirator with OV cartridges and pre-filter, and chemical goggles while applying. Handling procedures, PPE removal, and decontamination procedures were evaluated to be appropriate.

The handler is not a licensed applicator and there is no record of receiving WSDA 'hands on' pesticide training.

During this time period the handler had applied Guthion (Azinphos-methyl), a category I organophosphate pesticide, using the airblast method. Total hours of handling Guthion for the 30 days prior to testing was 33, and 33 for the year total.

No specific exposure incident was identified.

#### Violations:

WAC 296-307-13025(1) The employer did not ensure that one of its employees working as a handler had been trained in pesticide safety in the last 5-years.

WAC 296-800-17010 The employer did not have a complete list of all hazardous chemicals present in the workplace. Employees work with motor oil, diesel, and pesticides on a routine basis. Motor oil and diesel were not on the list.

WAC 296-800-17030 The employer did not provide workers with effective information and training on hazardous chemicals in their work area at the time of their initial job assignment.

### **Conclusion**

In conclusion, the 2011 cholinesterase monitoring program functioned as designed. The six action level cholinesterase depressions is the lowest yearly total since program began in 2004. While it is not possible to identify definitive reasons for the continued reduction in action level cholinesterase depressions, the sustained awareness of pesticide hazards and need for worker protections, and the feedback loop that monitoring provides are surely factors.

Laboratory testing is conducted in accordance with Standard Operating Procedures finalized in 2009. Quality control parameters for both serum and RBC cholinesterase testing remain with acceptable limits. PAML will continue to be the sole laboratory providing testing services through 2012.

DOSH would like to thank Dr. Barry Wilson and Jack Henderson, University of California Davis, for their continued support.

