



# **Cholinesterase Monitoring of Pesticide Handlers in Agriculture: 2012 Report**

---

Division of Occupational Safety and Health (DOSH)

**FEBRUARY 7, 2013**

**If you have questions about this report, please contact Pam Edwards, Industrial Hygienist,  
at 360-902-6457 or [edwp235@lni.wa.gov](mailto:edwp235@lni.wa.gov)**

## Executive Summary

The Division of Occupational Safety and Health (DOSH) administers an agriculture worker blood cholinesterase monitoring program under WAC 296-307-148<sup>1</sup>, Cholinesterase Monitoring. During the 2012 cholinesterase monitoring season (January 18 – September 16), ~307 growing operations and 2091 pesticide handlers participated in baseline cholinesterase testing. Two hundred and sixteen of these pesticide handlers were tested again (periodic testing) at least once during the pesticide application season. The great majority of handlers submitting periodic tests met the testing requirement threshold of handling toxicity class I or II organophosphate or N-methyl-carbamate pesticides for  $\geq 30$  hours in any consecutive 30 day period. However, in some cases employers scheduled testing regardless of number of handling hours.

Of these 216 handlers, 18 (8.3%) received at least one test indicating a cholinesterase activity depression of  $>20\%$  (action level) requiring the employer to evaluate pesticide handling practices. There were five action level cholinesterase depressions requiring temporary removal from handling organophosphate and n-methyl carbamate pesticides. All action level cholinesterase depressions occurred in Labor & Industries (L&I) Region 5<sup>2</sup>. Six growing operations (all separate employers) accounted for the 18 action level cholinesterase depressions.

The number of pesticide handlers establishing baselines in 2012 increased slightly over 2011 (2091 vs. 2017), while the number of handlers undergoing periodic testing remained relatively stable. Yearly testing numbers are believed to be affected by variations in factors including, but not limited to:

- a) Pest control strategies
- b) Use of class I and II cholinesterase inhibiting pesticides
- c) Employer actions resulting in limiting handler exposure (e.g., employee rotation).

All handlers with cholinesterase depressions at the action level were employed in the tree fruit industry, were characterized as mixer/loader/applicators. DOSH worksite field evaluations of action level cholinesterase depressions identified multiple Pesticide Worker Protection Standard violations that may have contributed to over-exposure including, but not limited to, training, respiratory protection, and personal protective equipment requirements. Toxicity class I and II cholinesterase inhibiting pesticides handled within the 30 days prior to periodic testing included Lorsban 4E, Guthion, and Carzol SP (Sevin 4F a Class III N-methyl-carbamate was also handled).

Pathology Associates Medical Laboratories (PAML) continues to conduct all laboratory analyses. Quality control indicators were well within limits and customer satisfaction remains high. PAML will continue to serve as the sole laboratory approved by DOSH in 2013.

In conclusion, the 2012 cholinesterase monitoring program functioned as designed. The program continues to provide value by maintaining awareness of hazardous chemicals and worker protections, and bolsters DOSH's ability to work directly with agriculture employers to solidify pesticide worker protection programs.

---

<sup>1</sup> [https://lni.wa.gov/safety-health/safety-rules/chapter-pdfs/WAC296-307.pdf#WAC\\_296\\_307\\_145](https://lni.wa.gov/safety-health/safety-rules/chapter-pdfs/WAC296-307.pdf#WAC_296_307_145)

<sup>2</sup> <https://lni.wa.gov/safety-health/preventing-injuries-illnesses/request-consultation/>

## Background

Acetylcholinesterase (AChE) is an enzyme that removes the chemical neurotransmitter acetylcholine from the junctions between nerve cells. AChE effectively serves as the nerve cell “off switch” and is essential to normal nervous system function. Certain pesticides, known as cholinesterase inhibitors, bind with AChE resulting in over-excitement of nervous system pathways.

Exposure to organophosphate or N-methyl-carbamate pesticides may lower the level of active cholinesterase in the nervous system. Depressed cholinesterase activity may lead to physical symptoms ranging from malaise, blurred vision, and diarrhea, and in extreme cases, coma and death. Laboratory monitoring of cholinesterase levels in the blood (both serum and red blood cell [RBC] cholinesterase) detects reductions in cholinesterase activity prior to the onset of symptoms (pesticide illness), as well as provides information regarding pesticide exposure and the effectiveness of exposure control measures. Cholinesterase levels may be affected by such factors as liver and blood disease, and certain medications; in the absence of such factors, cholinesterase depression is most likely caused by over-exposure to the cholinesterase inhibiting pesticides handled by these workers. Previous reports provide detailed background and describe cholinesterase monitoring experiences during the years 2004 through 2010<sup>3</sup>.

WAC 296-307-148, Cholinesterase Monitoring (the rule), was adopted in December 2003 and has remained unchanged after amendments were made in 2005. The rule requires agriculture employers to: a) record hours employees handle<sup>4</sup> toxicity class I and II organophosphate and N-methyl-carbamate pesticides (covered pesticides); b) provide cholinesterase blood testing to employees who handle covered pesticides for 30 or more hours in any consecutive 30 day period; and c) 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. Health care provider recommendations include verification of testing, actions to be taken based on cholinesterase activity, and any recommendations regarding further medical evaluation.

DOSH offers consultation services to agriculture employers with pesticide handlers who experience a cholinesterase depression >20% (action level cholinesterase depression). In addition to assisting with an evaluation of the employer’s pesticide worker protection program and the pesticide handler’s work practices, information on pesticide handling practices and equipment is gathered. DOSH compliance inspections are opened in certain circumstances such as clusters of action level cholinesterase depressions, and employer refusal to accept consultation services.

DOSH continued to provide reimbursement to employers for testing services and related administrative program costs<sup>5</sup>. Forty-seven employers requested and were granted reimbursements totaling \$52,000. This is a substantial reduction from an average of \$109,000 over the previous three years.

---

<sup>3</sup> Previous reports can be found at <https://lni.wa.gov/safety-health/safety-topics/search-by-topic?query=cholinesteraseMonitoring>

<sup>4</sup> Pesticide handling is defined in WAC 296-307-11005

<sup>5</sup> The Cholinesterase Monitoring reimbursement request form can be found at <https://lni.wa.gov/forms-publications/F413-062-000.pdf>

The following table outlines participation and monitoring outcomes for the years 2007-2012 of the cholinesterase monitoring program.

	2007	2008	2009	2010	2011	2012
<b># growing operations*</b>	226	218	217	315	388	307
<b># Handlers submitting baseline tests</b>	1857	2013	2056	1989	2017	2091
<b># Handlers declining testing</b>	167	192	229	Data not collected	Data not collected	Data not collected
<b># Working baselines</b>	120	71	29	51	43	47
<b># Handlers with <math>\geq 1</math> periodic test</b>	386	314	249	257	186	148
<b># Periodic tests</b>	532	495	286	316	202	216
<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%)	13 (6.0%)
<b># Handlers with ChE depression to exposure removal level</b>	18(4.6%)	1(0.1%)	7(2.8%)	0	0	5(2.3%)
<b>Total # handlers with AL ChE depression</b>	67(17.3%)	22(7.0%)	22(8.8%)	8(3.1%)	6(3.2%)	18 (8.3%) **
<b># Handlers reporting pesticide illness symptoms</b>	0	0	0	0	0	0

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

\*\*13 serum and 5 RBC cholinesterase depressions

## Medical Services

Seventeen medical clinics provided blood collection and medical evaluation services. Thirteen clinics are located in Region 5, three in Region 1, and one in Region 4<sup>6</sup>. In preparation for the 2012 monitoring season, DOSH contacted all participating clinics and provided guidance with the rule and cholinesterase medical monitoring guidelines. All clinics reported satisfaction with the laboratory services and support provided by DOSH.

Pathology Associates Medical Laboratories (PAML) in Spokane is the sole laboratory approved to provide testing services. There were no changes in Standard Operating Procedures<sup>7</sup> from 2012

<sup>6</sup> <https://lni.wa.gov/agency/find-a-job/>

<sup>7</sup> Available upon request

to 2012. Blood samples are packed in ice and picked up at the clinic using same-day courier services. Samples are analyzed within 24 hours of collection and reported to both the 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.

DOSH chemists regularly review PAML quality control reports and conduct onsite visits. All quality control indicators demonstrated good precision throughout the season.

### **Monitoring Summary**

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

During the 2012 cholinesterase testing season (January 18 – September 16), ~315 growing operations participated in testing and 2091 handlers submitted cholinesterase baseline samples, with baseline submissions increasing over 2011 (2017).

Of the 148 pesticide handlers who received at least one periodic test, 13 (6.0%) received a periodic test result having a >20 percent cholinesterase activity depression from baseline (action level cholinesterase depression) requiring the employer to evaluate handling practices for possible deficiencies. 5 (2.3%) handlers experienced cholinesterase depression levels requiring temporary removal from handling organophosphate and N-methyl-carbamate pesticides a serum cholinesterase depression of  $\geq 40\%$  or RBC cholinesterase depression of  $\geq 30\%$ . The 18 handlers (15 serum and 3 RBC action level cholinesterase depression) worked for six different growing operations.

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

All six of the growing operations with handlers who had experienced action level cholinesterase depression received site visits from DOSH. Three 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.

**Conclusion**

In conclusion, the 2012 cholinesterase monitoring program functioned well. The 18 action level cholinesterase depressions found represented an increase over the previous year. 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 protections and feedback loop that monitoring provides, are certainly factors.

More work is still needed as evidenced by finding multiple rule violations during worksite evaluations and also the fact that some handlers still do not consistently receive copies of health care provider written recommendations. One concern consistently noted during worksite evaluations was often finding the employer provided handler training to be of limited quality. This area will likely receive additional attention in the future.

Laboratory testing is conducted in accordance with Standard Operating Procedures finalized in 2009. Quality control parameters for both serum and RBC cholinesterase testing remain within acceptable limits. PAML will continue to be the sole laboratory providing testing services through 2013.