Best Management Practices to Protect Water and Fish

DIAZINON

Broad-spectrum insecticide, mostly restricted use

Products Include: Corathon, Diazinon, Patriot, Optimizer, Warrior

Diazinon is a Concern in Oregon's Willamette Valley Streams

Diazinon is likely to adversely affect five threatened species of chinook salmon, coho salmon and winter steelhead found in the Willamette Basin, as well as their designated critical habitat, based on the toxic effects of diazinon at predicted aquatic concentrations and exposure potential.[1]

The Chemical Properties of Diazinon Predispose It to Be a Water Pollutant

Chemical Property	Diazinon Rank[2]	Why it Matters for Pollution
Solubility	Moderate	More soluble pesticides dissolve easily in water, moving with rainfall or soil water into streams or groundwater.
Volatility	Moderate	More volatile pesticides have a tendency to evaporate and move off-site after application.
Bioconcentration	Moderate	Pesticides that concentrate in fish or wildlife may harm the animal or create a hazard when eaten. Such pesticides are typically lipophilic (fat-loving) and may also accumulate (magnify) in the food chain.
Breakdown in Water	Resistant	Pesticides can break down by reacting with water (hydrolysis), light (photolysis) or interacting with live organisms (metabolic). Diazinon is resistant to both hydrolysis (at neutral pH) and photolysis, which means it can last longer in water.

Rank: red – yellow – green shading above indicates relative risk of pollution (red high).

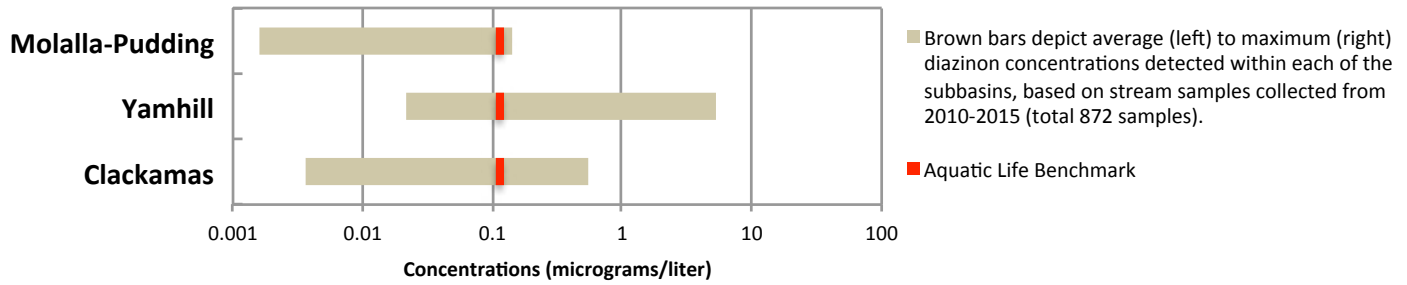
Harmful Effects of Diazinon to Salmon, Steelhead or Their Habitat

Diazinon concentrations within the range of those documented in the Willamette subbasins have been documented to harm fish and aquatic invertebrates in many different studies, suggesting that salmon, steelhead and their prey are vulnerable to diazinon levels present in local streams. Documented adverse effects include:[3]

- Effects to fish growth, reproduction and behavior (at concentrations approximately 0.1 to 1 micrograms/liter),
- Inhibition of enzymes critical for neural functioning (for some test fish, inhibition occurred at concentrations below the average levels seen in the Molalla Pudding and Clackamas), and
- Mortality of sensitive aquatic invertebrates and reproductive impacts (at concentrations between 0.1 to 2 micrograms/liter).

Photo: Alex Weinberg

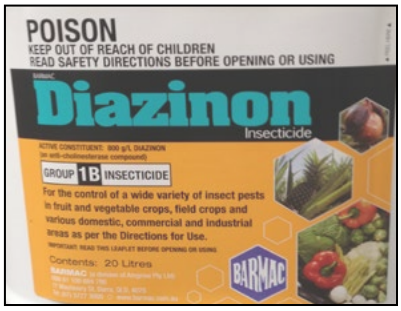
Diazinon Concentrations in Willamette Valley Streams Can Far Exceed Levels Set to Protect Aquatic Life and Clean Water[4]



Pay Attention to the Label

All diazinon labels warn that the product is **highly toxic** to fish. Products for field usage state:

> **Drift and runoff may be hazardous to aquatic organisms in neighboring areas.** Keep out of lakes, streams, ponds, tidal marshes, and estuaries. Shrimp and crab may be killed at application rates recommended on this label. Do not apply where fish, shrimp, crab, and other aquatic life are important resources.



Aerial applications are allowed only for lettuce. Applications of diazinon are subject to a 2014 court order for interim salmon protection that **requires no-spray buffers adjacent to salmon-supporting waters (60 feet for all ground or granular applications and 300 feet for all aerial applications).** See maps and information online at Salmon Mapper.[5]

Registered Uses in Oregon

Foods: A variety of tree fruit and berries, wide variety of vegetables, hazelnuts
Nursery/Tree: Conifers and commercial ornamentals grown outdoors in nurseries
Other: Cattle ear tags

Alternative Strategies to Reduce Insect Pressure

- Promote plant vigor by maintaining healthy soil,[6] and plant pest-resistant cultivars if available.
- Prevent or suppress pests with cultural strategies where possible and recommended, to make the area less hospitable to the pest. For example, delaying planting dates can inhibit pests such as flea beetles and cabbage maggots. Certain crop rotations interrupt the life cycle for wireworms, Colorado potato beetle, and symphylans.[7] Removing known alternate hosts reduces pest resources.
- Pheromones (chemicals produced by an insect to communicate) can be used in many crops for monitoring—or for mass trapping or mating disruption, suppressing insect populations.[8] Mating disruption for codling moth is currently used on 90% of the apple and pears grown in Washington State.
- Use exclusions or barriers where feasible.
- Support biological pest control by natural enemies (predators or parasites on the pest). Many biocontrols can be purchased from commercial providers. Conserving or creating on-farm habitats (such as beetle banks, cover crops, alley cover crops or hedgerows) supports native natural enemies (conservation biocontrol).[9] Such habitats also provide habitat for native pollinators, important to many Oregon crops. Research appropriate plants to ensure the biocontrol habitats don't increase host plants for pests of concern.
- Mass-trap pests using trap crops, pheromone technology or baits. Mass-trapping with the aid of a pheromone was found to significantly reduce western flower thrip in strawberries.[10] In Washington and Idaho, trap crop designs including mustard, rape, and pak choi were found to reduce populations of flea beetles on broccoli more effectively than trap crops with only one species.[11]
- Check with Oregon State, Washington State, or University of California extension for advice on specific pests.

Protect Fish – Keep it Out of the Water

National Marine Fisheries Service Recommendations to Protect Salmon

National Marine Fisheries Service is assessing the risk of diazinon to threatened and endangered salmon. By December 2017, NMFS recommendations to protect salmon will be posted at http://www.nmfs.noaa.gov/pr/consultation/pesticides.htm.

Recycling Tunnel Sprayer | Photo: Yamhill Soil and Water Conservation District

Suggested Best Management Practices

Especially adjacent to permanent water bodies or on sloped or frequently flooded sites

Reduce Drift and Volatilization:

1. Apply only when wind speeds are between 2-8 mph, only when winds are blowing away from streams and only when temperatures are lower than 70°F.
2. Diazinon is more prone to volatilize from dry soils than moist soils;[12] be aware of soil moisture conditions and air temperatures to minimize the risk of volatilization.
3. Adjust nozzles to coarse droplet sizes. For airblast sprayers, airflow adjustment is important. Studies show airflow adjustments result in an 82% improvement in spray deposition, with a corresponding spray drift reduction of 70%.[13] Also, use shields, precision or "smart" sprayers, or other drift reduction technology. Tunnel sprayers designed to contain and recycle spray over berry and vineyard rows also result in far less drift than conventional airblast sprayers, reducing drift by up to 95%, and reducing chemical usage by 40%.[14]
4. Increase untreated setbacks (no-spray buffers) next to streams, especially for aerial applications or if no windbreak or drift barrier is present. A setback of 100 feet for ground applications reduces the modeled drift fraction to about 2%, compared to no buffer.[15]

Reduce Runoff and Erosion:

1. Reduce application rates, spot spray or conduct banded or bait applications.
2. Avoid application when run-off generating rainfall is expected.
3. Techniques to promote infiltration and reduce erosion include:
   -Strip cropping (strips of perennial vegetation alternated with cultivated strips on contours),
   -"Perms" (grass strips) or cover crops between rows of conifer plantations, berries, orchard crops, or grapes,[16]
   -Reduced-tillage, which helps maintain organic material on site, holding soil in place,
   -Straw ropes, laid across the contour on sloped sites, to slow runoff and erosion.[17]
4. Infiltrate concentrated, channeled runoff leaving the treated sites using grassed waterways.[18] Sediment-control measures such as grass-filter strips or sediment-retention ponds can be helpful. Such techniques trap sediment and promote infiltration, reducing pesticide loading to adjacent ditches and streams. While large variability exists, a review found, on average:[19]
   -a 17 ft. wide vegetative strip reduces pesticide loading by 50%,
   -a 33 ft. wide vegetative strip reduces pesticide loading by 90%,
   -a 67 ft. wide vegetative strip reduces pesticide loading by 97%.

Pesticide Selection:

1. Use a pesticide that is less toxic (check SDS sheets or talk to your crop consultant or extension specialist). Botanical extracts and microbials are effective against many pests and widely available, and these products can be less toxic to non-targets.
2. Avoid tank mixes and formulations containing multiple active ingredients, which may cause additive or synergistic effects.

Photo: Pacific Northwest National Laboratory

1 Environmental Protection Agency. 2017. Biological Evaluation Chapters for Diazinon ESA Assessment. Appendix 4-1-4. https://www.epa.gov/endangered-species/biological-evaluation-chapters-diazinon-esa-assessment#append3.

2 Values cited in U.S. EPA, Appendix 3-1-3 (endnote 1). Rankings follow National Pesticide Information Center (NPIC) classification, or as interpreted by U.S. EPA.

3 See summary of studies presented in U.S EPA, 2017, Chapter 2 (endnote 1).

4 Oregon Pesticide Stewardship Partnership Program data, 2010-2015. Samples collected 7-14 days apart during growing season. Sampling sites may not represent first-order streams and small static water bodies adjacent to pesticide use areas, thus sampling data may underestimate true peaks and averages.

5 U.S. EPA. Salmon Mapper: Pesticide Use Limitations in California, Oregon, and Washington State. https://www.epa.gov/endangered-species/salmon-mapper.

6 Magdoff, F. and H. Van Es. 2009. Building Soil for Better Crops. USDA SARE program, http://www.sare.org/Learning-Center/Books/Building-Soils-for-Better-Crops-3rd-Edition.

7 Stoner, K. 2009. Management of insect pests with crop rotation and field layout. http://www.sare.org/Learning-Center/Books/Crop-Rotation-on-Organic-Farms/Text-Version/Physical-and-Biological-Processes-In-Crop-Production/Management-of-Insect-Pests-with-Crop-Rotation-and-Field-Layout. Also see Umble J. [and others]. 2006. Symphylans: Soil Pest Management Options. https://attra.ncat.org/attra-pub/viewhtml.php?id=127ATTRA.

8 Washington State University. Mating Disruption. http://jenny.tfrec.wsu.edu/ opm/displaySpecies.php?pn=-80.

9 Mader, E., J. Hopwood [and others]. 2014. Farming with native beneficial insects. The Xerces Society: Storey Publishing.

10 Sampson C, and W. Kirk. 2013. Can mass trapping reduce thrips damage and is it economically viable? Management of the Western flower thrips in strawberry. PLoS ONE 8(11): e80787. https://doi.org/10.1371/journal.pone.0080787.

11 Parker, J., D. Crowder [and others]. 2016. Trap crop diversity enhances crop yield. Agriculture, Ecosystems and Environment 232:254-262. http://entomology.wsu.edu/david-crowder/files/2016/09/2016_parker-et-al_ag-ecosyst-environ.pdf.

12 U.S. EPA, Appendix 3-1-3 (endnote 1).

13 Landers, A. 2011. Improving Spray Deposition with Engineering Innovation. https://grapesandwine.cals.cornell.edu/sites/grapesandwine.cals.cornell.edu/files/shared/documents/Landers-Research-Focus-2011-1.pdf.

14 Ade, G., G. Molari, and V. Rondelli. 2005. Vineyard evaluation of a recycling tunnel sprayer. American Society of Agricultural Engineers. 48(6): 2102-2112. See also Vicksta, M. 2015. Yamhill Soil and Water Conservation District. 2012. Recycling Tunnel Sprayer Results Report, CIG.

15 U.S. EPA, Appendix 3-3-2 (endnote 1).

16 Pacific Northwest Extension Publication PNW 625. 2011. Weed and Vegetation Management in Christmas Trees.

17 Ibid.

18 USDA Natural Resources Conservation Service. 2000. Conservation Buffers to Reduce Pesticide Losses. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_023819.pdf.

19 European Crop Protection Association, 2009. Vegetative Buffer Strips, http://abe.ufl.edu/Carpena/files/pdf/software/vfsmod/VFS_Flyer_07_09_09__FINAL.pdf.

NORTHWEST CENTER FOR ALTERNATIVES TO PESTICIDES

June 2017. Financial support for the development of this document was provided by:
The Oregon Pesticide Stewardship Partnership Program, Spirit Mountain Community Fund and Jubitz Family Foundation.

NCAP works to protect community and environmental health and inspire the use of ecologically sound solutions to reduce the use of pesticides.

WWW.PESTICIDE.ORG | INFO@PESTICIDE.ORG