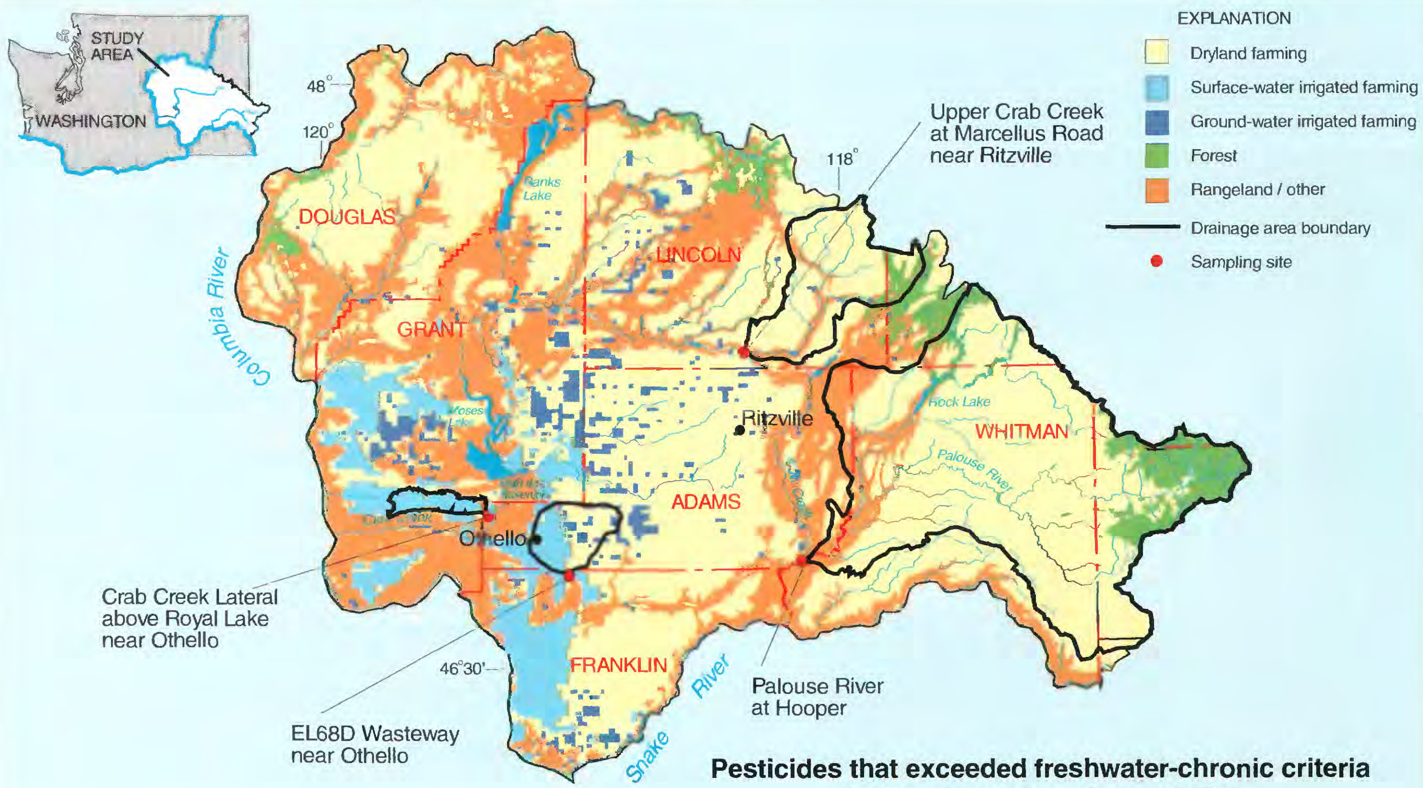
U.S. Department of the Interior
U.S. Geological Survey

Are Agricultural Pesticides in Surface Waters of the Central Columbia Plateau?

USGS

Fact Sheet 241-95
Revised

YES. Many agricultural pesticides are present at very low concentrations. No pesticides were found at concentrations above regulatory drinking water standards, but some were at concentrations that exceeded guidelines for the protection of aquatic life (freshwater-chronic criteria) or health advisories for drinking water.



Pesticides that exceeded freshwater-chronic criteria for the protection of aquatic life

Pesticide (trade name)[1]	Number of samples that exceed criteria at: EL68D Wasteway	Crab Creek Lateral	Upper Crab Creek	Palouse River
Chlorpyrifos (Lorsban)	3	3	--	--
Azinphos-methyl (Guthion)	3	12	1	--
Carbaryl (Sevin)	0	2	0	--
Diazinon (several)	3	1	--	1
Triallate (Far-Go)	--	--	1	3

[1]Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Geological Survey.

- Surface-water sites representing four drainage basins with different farming practices were sampled by the U.S. Geological Survey as part of its National Water-Quality Assessment Program. Samples were taken one to five times a month from March 1993 through May 1994.
- Detections of pesticides usually, but not always, were related to pesticides used on crops in the drainage basins (see inside).
- Of the 84 compounds targeted for analysis, 45 compounds were detected. No pesticides were found at concentrations that exceeded U.S. Environmental Protection Agency (USEPA) maximum contaminant levels for drinking water, but concentrations of dieldrin and *alpha*-HCH exceeded their USEPA health advisories for drinking water.
- Five pesticides were at concentrations that could adversely affect aquatic life.

WHY ARE SOME PESTICIDES FOUND MORE OFTEN THAN OTHERS?

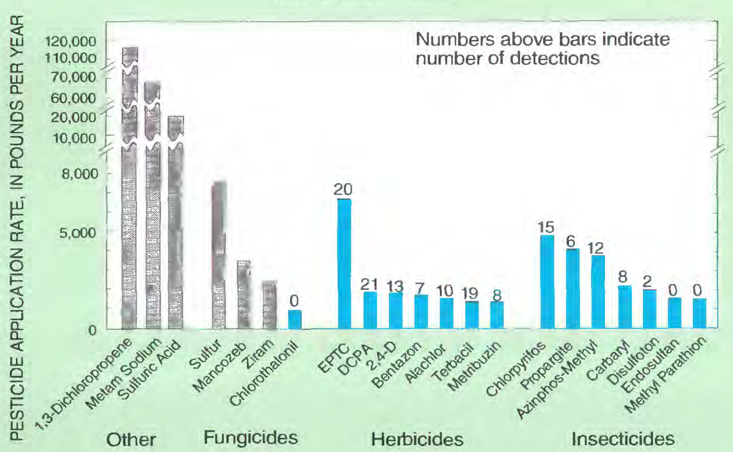
- **AGRICULTURAL PESTICIDE USE** is often a factor that explains detection frequencies, but not always.
- **APPLICATION RATES,** which may influence detection frequencies, are difficult to determine.
- **NON-AGRICULTURAL USE** may help explain detections of some pesticides.
- **OTHER FACTORS** influencing detection rates include (1) analytical methods with different limits of detection, (2) the rate at which different pesticides break down in water and soil environments, and (3) the ability of pesticides to dissolve and be transported by water. For example, atrazine, the most commonly detected pesticide, has a very low detection level, dissolves readily in water, and breaks down very slowly in water, but its agricultural usage rate is less than 5 percent of the total herbicides applied in the drainage basins sampled.

PESTICIDE APPLICATION RATES

IRRIGATED AGRICULTURAL DRAINAGE BASINS

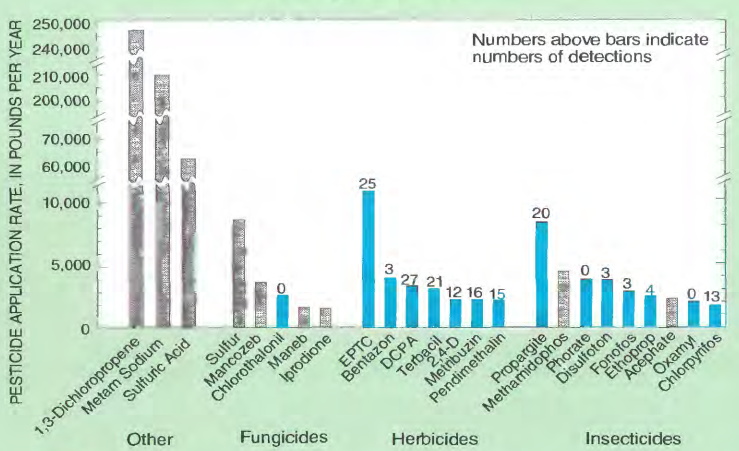
Crab Creek Lateral--(29 samples)

(56 square miles)



EL68D Wasteway--(29 samples)

(146 square miles)



Pesticide analyzed | Pesticide not analyzed

Pesticides that make up 5 percent or more of the total applications in each pesticide group are shown (applications of oil or petroleum distillates are not included). Application rates are given in pounds of active ingredient applied per year and are based on information from Anderson and Gianessi (1995). Not all pesticides applied were targeted for analysis.

MAXIMUM CONCENTRATIONS OF DETECTED PESTICIDES

[µg/L, micrograms per liter (or parts per billion); --, no data available; -, pesticide was not detected; concentrations in red exceeded the criteria for the protection of aquatic life; concentrations in green exceeded the health advisory for drinking water]

Pesticide or metabolite (m)	Trade name	Method detection limit or reporting level (µg/L)	Criteria[1] (µg/L)	Maximum concentrations at: Irrigated: EL68D Wasteway (µg/L)	Irrigated: Crab Creek Lateral (µg/L)	Dryland: Upper Crab Creek (µg/L)	Dryland: Palouse River (µg/L)	Number of detections at: All	Irrigated: EL68D Wasteway	Irrigated: Crab Creek Lateral	Dryland: Upper Crab Creek	Dryland: Palouse River
Herbicides												
Atrazine	AAtrex	0.009	[2]2	0.02	0.05	0.03	0.2	79	25	29	2	23
Simazine	Aquazine	0.005	[3]10	0.019	0.073	0.042	0.069	77	19	21	13	24
DCPA	Dacthal	0.002	--	8.1	0.99	0.002	0.006	61	27	21	1	12
EPTC	Eptam	0.002	--	0.41	1.8	0.008	0.012	53	25	20	1	7
Desethylatrazine[4](m)	none	0.002	--	E0.01	E0.02	E0.005	E0.006	45	11	23	2	9
Metolachlor	Dual	0.002	[5]8	0.019	0.042	-	0.004	40	19	18	0	3
Terbacil[4]	Sinbar	0.007	--	E0.6	E0.7	-	-	40	21	19	0	0
Alachlor	Lasso	0.002	--	0.3	0.03	0.01	0.006	38	25	10	1	2
Metribuzin	Lexone	0.004	[5]1	0.1	0.022	-	0.052	33	16	8	0	9
2,4-D	several	0.035	[3]3	1.3	1.7	0.24	0.15	30	12	13	2	3
Triallate	Far-Go	0.001	[5]0.24	-	-	0.65	0.49	30	0	0	6	24
Trifluralin	Treflan	0.002	[2]0.1	0.096	0.01	-	0.007	26	15	10	0	1
Pendimethalin	Prowl	0.004	--	0.19	0.016	-	-	25	15	10	0	0
Prometon	Pramitol	0.018	--	-	0.008	0.01	0.058	20	0	2	1	17
Ethalfluralin	Sonalan	0.004	--	0.038	0.028	-	0.013	13	7	5	0	1
Diuron	Karmex	0.02	[3]1.6	0.33	0.39	0.07	0.47	12	6	2	1	3
Bentazon	Basagran	0.014	--	0.14	0.11	-	-	10	3	7	0	0
Cyanazine	Bladex	0.004	[5]2	0.04	0.014	-	-	9	6	3	0	0
Butylate	Sultan +	0.002	--	0.006	0.007	-	-	9	6	3	0	0
Tebuthiuron	Spike	0.01	--	-	0.028	-	0.01	6	0	1	0	5
MCPA	Metaxon	0.05	--	-	-	-	0.24	5	0	0	0	5
Bromoxynil	Buctril	0.035	[2]5	0.09	-	-	0.6	5	3	0	0	2
Linuron	Lorox	0.002	--	0.009	0.022	-	-	5	1	4	0	0
Napropamide	Devrinol	0.003	--	0.007	0.017	-	-	3	1	2	0	0
Propanil	Stampede	0.004	--	-	0.014	-	-	2	0	2	0	0
Thiobencarb	Bolero	0.002	--	-	0.005	-	-	2	0	2	0	0
Propham	Chem-Hoe	0.035	--	0.06	-	-	-	1	1	0	0	0
Propachlor	Ramrod	0.007	--	-	0.002	-	-	1	0	1	0	0
Benfluralin	Balan	0.002	--	-	0.003	-	-	1	0	1	0	0
Dacthal, mono-acid	none	0.017	--	0.04	-	-	-	1	1	0	0	0
Insecticides												
Chlorpyrifos	Lorsban	0.004	[6]0.041	0.066	0.12	-	-	28	13	15	0	0
Propargite	Comite	0.013	--	1.4	0.12	-	-	26	20	6	0	0
Dieldrin[7]	Panoram D-31	0.001	[6]0.065	0.016	0.01	-	0.01	25	15	8	0	2
Azinphos-methyl[4]	Guthion	0.001	[6]0.01	E0.5	E0.2	E0.04	-	16	3	12	1	0
Carbofuran[4]	Furadan	0.003	[2]1.75	E0.1	E0.006	-	-	12	11	1	0	0
Ethoprop	Mocap	0.003	--	0.007	0.12	-	0.005	11	4	5	0	2
Carbaryl[4]	Sevin	0.003	[3]0.02	E0.004	E0.1	E0.02	-	11	1	8	2	0
gamma-HCH	Lindane	0.004	[6]0.08	-	-	-	0.036	9	0	0	0	9
Diazinon	several	0.002	[3]0.009	0.052	0.018	-	0.012	7	4	2	0	1
Malathion	several	0.005	[6]0.1	0.019	0.025	-	-	5	3	2	0	0
Disulfoton	Di-Syston	0.017	[3]0.05	0.035	0.011	-	-	5	3	2	0	0
p,p'-DDE (m)	none	0.006	--	-	0.008	-	-	4	0	4	0	0
Fonofos	Dyfonate	0.003	--	0.013	-	-	-	3	3	0	0	0
cis-Permethrin	Ambush	0.005	--	-	E0.01	-	-	1	0	1	0	0
alpha-HCH[7]	none	0.002	--	-	-	-	0.007	1	0	0	0	1
Number of samples analyzed								*104*	*29*	*29*	*19*	*27*

[1]*Freshwater-chronic criteria for the protection of aquatic life*

[2]*Guidelines are freshwater-chronic criteria for the protection of freshwater aquatic life from Canadian Water Quality Guidelines prepared by Canadian Council of Ministers of the Environment (1993)*

[3]*Freshwater-chronic criteria for the protection of aquatic life recommended by National Academy of Sciences and National Academy of Engineers (1973) from Nowell and Resek(1994)*

[4]*Concentrations for these pesticides are qualitatively identified*

[5]*Interim guidelines for the protection of aquatic life are Canadian Water Quality Guidelines from Canadian Council of Ministers of the Environment (1993)*

[6]*U.S. Environmental Protection Agency freshwater-chronic ambient-water-quality criteria for protection of aquatic life, from Nowell and Resek (1994)*

[7]*Dieldrin and alpha-HCH were detected at concentrations above their USEPA health advisories for drinking water (0.002 µg/L and 0.006 µg/L, respectively), from Nowell and Resek (1994)*

[E]*Concentration qualitatively identified and reported as an estimated value*

VARIATIONS IN THE FREQUENCY OF DETECTIONS

in both the dryland and irrigated basins were observed.

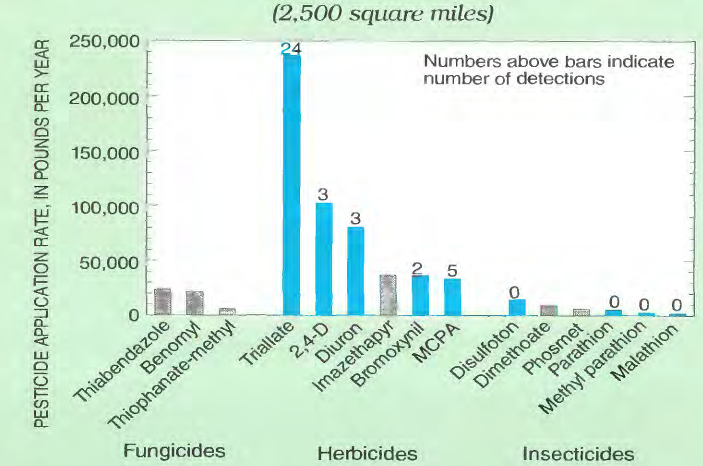
- **Herbicides are detected more often than insecticides** in both the irrigated and dryland basins.
- **Herbicides are applied in greater amounts than insecticides** in the dryland drainage basins.
- **Some herbicides**, triallate and MCPA for instance, were detected only in the dryland drainage basins.
- **Terbacil and pendimethalin** are two herbicides that were detected only in the irrigated drainage basins.

PESTICIDE APPLICATION RATES

DRYLAND AGRICULTURAL DRAINAGE BASINS

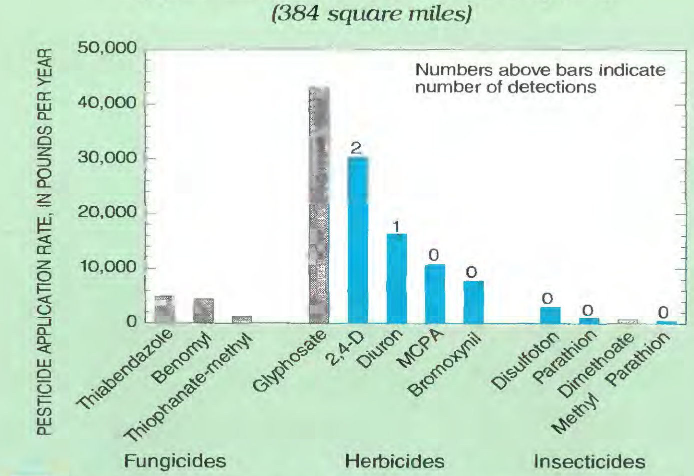
Palouse River--(27 samples)

(2,500 square miles)



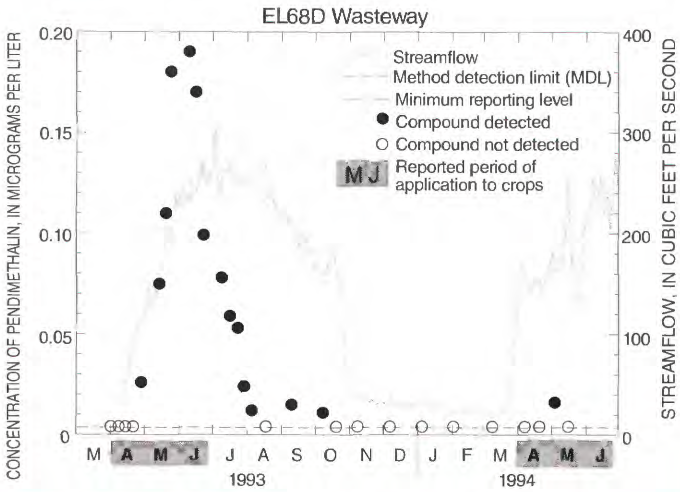
Upper Crab Creek--(19 samples)

(384 square miles)

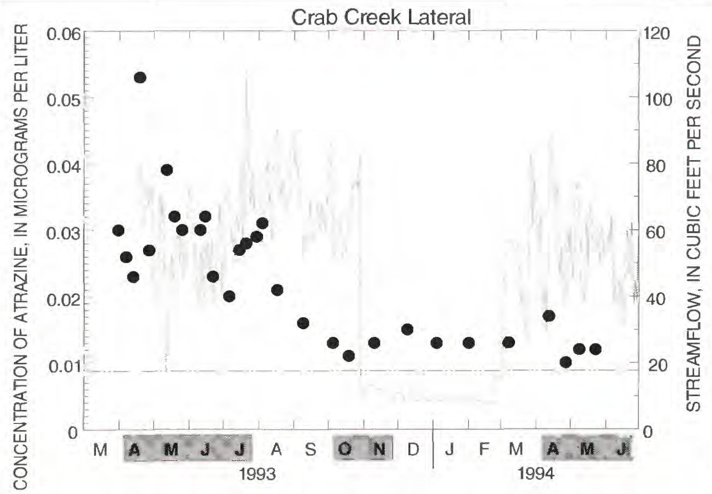


Pesticide analyzed | Pesticide not analyzed

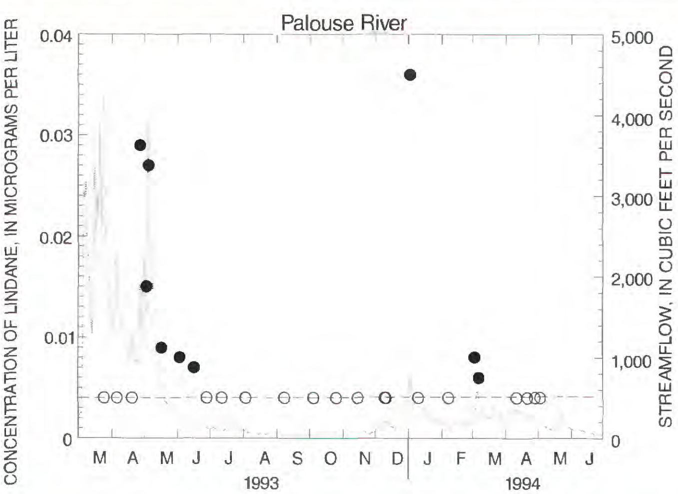
Pesticides that make up 5 percent or more of the total applications in each pesticide group are shown (applications of oil or petroleum distillates are not included). Application rates are given in pounds of active ingredient per year and are based on information from Anderson and Gianessi (1995). Not all pesticides applied were targeted for analysis. Pesticides not included in the fungicide, herbicide, or insecticide groups make up less than 0.5 percent of all pesticides applied.



Highest concentrations of pendimethalin were detected during or shortly after the period when it is typically applied.



The presence of atrazine during low streamflows (November to mid-March) indicates that the ground water is one source of atrazine to the surface water.



Detections of *gamma*-HCH (Lindane) coincide with periods of surface runoff.

VARIATIONS OF CONCENTRATIONS of pesticides in surface waters sometimes provide clues about how the pesticides are transported to surface-water systems.

- Highest concentrations of some pesticides were observed during or shortly after their application period.
- Pesticides enter surface waters in runoff from fields and through the ground-water system.

References

Anderson, J.E., and Gianessi, L., 1995, Pesticide use in the Central Columbia Plateau: Washington, D.C., National Center for Food and Agricultural Policy, misc. pagination.

Nowell, L.H., and Resek, E.A., 1994, Summary of National Standards and Guidelines for pesticides in water, bed sediment, and aquatic organisms and their applications to water-quality assessments: U.S. Geological Survey Open-File Report 94-44, 115p.

Wagner, R.J., Ebbert, J.C., Roberts, L.M., and Ryker, S.J., in press, Agricultural pesticide applications and observed concentrations in surface waters from four drainage basins in the Central Columbia Plateau, Washington and Idaho, 1993-94: U.S. Geological Survey Water-Resources Investigations Report 95-4285, [about 50] p.

Additional graphs of this type, as well as summary data, are published in Wagner and others, in press (available at the contact listed below).

In June 1996 the USGS National Water Quality Laboratory completed adjustments to the pesticide data base from schedules 2001/2010 and 2050/2051 covering sample dates from 1992 through February 29, 1996. Corrected method detection limits (MDLs) were assigned to nondetect values and E (estimate) codes were assigned more consistently. Also, all dimethoate values were deleted from the data base due to this compound's poor performance in analytical tests. While making these adjustments to the data base, it was discovered that some compounds detected at very low concentrations had been inadvertently reported as nondetections. These are now reported as detections. This most frequently occurred for the following compounds: desethylatrazine, dieldrin, simazine, propargite, disulfoton, and linuron.

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
National Water-Quality Assessment Program
USGS Fact Sheet 241-95
prepared by
R. J. Wagner, J. C. Ebbert, and L.M. Roberts

For further information contact:
Project Chief
Central Columbia Plateau NAWQA
1201 Pacific Ave., Suite 600
Tacoma, WA 98402
(206) 593-6510 Email: nawqa_ccpt_wa@usgs.gov
World Wide Web: http://wwwdwatcm.wr.usgs.gov/ccpt.nawqa.html

July 1996