DEPARTMENT OF PESTICIDE REGULATION (DPR) Date: March 1, 2024

SURFACE WATER AMBIENT MONITORING REPORT

1. Study highlights

- DPR Study Number 310
- SURF (Surface Water Database) Study Number 658
- Study Title **Surface Water Monitoring for Pesticides in Agricultural Areas of Northern California, 2022**
- Project Lead Mason Zoerner
- Email Mason.Zoerner@cdpr.ca.gov
- Protocol Source (*protocol available online for five years, thereafter, request a copy from the SWPP list of archived files)*
  Environmental Monitoring Protocol Page

- Study Area

  County: Butte, Colusa, Merced, Stanislaus, Sutter, Yolo

  Waterbody/Watershed: Lower Logan Creek, Willow Creek, Clarks Ditch-Colusa Basin Drain, Lower Cottonwood Creek, South Slough-Deadman Creek, Town of Hilmar-San Joaquin River, Ingram Creek

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- Land use type ☒ Ag ☐ Urban ☐ Forested ☐ Mixed ☐ Other

- Water body type

  ☒ Creek ☐ River ☐ Pond ☐ Lake

  ☒ Drainage Ditch ☐ Storm drain outfall ☐ Other Enter other type

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- Objectives

1) Determine the presence and concentrations of selected pesticides in surface waters and sediments collected from selected sites; 2) Assess potential impacts to aquatic organisms by comparing measured pesticide concentrations to United States Environmental Protection Agency (USEPA) aquatic life benchmarks; 3) Determine the toxicity of collected water samples using toxicity tests conducted on representative test organisms.

- Sampling period May 2022 to December 2022

- Major findings

INSECTICIDES IN WATER: Overall, the most frequently detected insecticidal active ingredients (AIs) were as follows: methoxyfenozide (66%), chlorantraniliprole (29%), bifenthrin (24%), imidacloprid (20%), clothianidin (9%), and methomyl (9%). AIs with detection frequencies (DFs) between 2% and 8% included acetamiprid, fenpropathrin, esfenvalerate, lambda cyhalothrin, dinotefuran, dimethoate,

abamectin, etofenprox, indoxacarb, propargite, fipronil, and pyriproxyfen. Other monitored insecticides were not detected in any samples collected during 2022. Insecticides with the greatest exceedances (exceedance frequency (EF)) of their lowest USEPA aquatic life benchmarks (BMs) included imidacloprid (26% EF), bifenthrin (24% EF), clothianidin (6% EF), fenpropathrin (6% EF), esfenvalerate (6% EF), lambda cyhalothrin (6% EF), methomyl (3% EF), pyriproxyfen (3% EF), and fipronil (3% EF).

HERBICIDES AND FUNGICIDES IN WATER: Listed by greatest DF, herbicides that were detected included oxyfluorfen (75%), thiobencarb (37%), pendimethalin (25%), diuron (23%), hexazinone (23%). s-metolachlor (14%), propanil (9%), bensulide (3%), and oxadiazon (3%). Herbicides that exceeded aquatic life BMs included oxyfluorfen (25% EF), thiobencarb (6% EF), and diuron (3% EF). Fungicides detected in 2022 included azoxystrobin (77%), propiconazole (34%), trifloxystrobin (3%), tebuconazole (3%), quinoxyfen (3%), cyprodinil (3%), and pyraclostrobin (3%). There were no fungicide concentrations that exceeded aquatic life BMs. Other monitored herbicides and fungicides were not detected in any sample collected in 2022.

PYRETHROIDS IN SEDIMENT: Three sediment samples were collected in September 2022 from the Sacramento and San Joaquin Valleys. Samples were screened for bifenthrin, cyfluthrin, cypermethrin, esfenvalerate/fenvalerate, lambda cyhalothrin, and permethrin. The DF of bifenthrin and lambda cyhalothrin were 33%. Other pyrethroids were not detected in sediment samples collected during the sampling year.

TOXICITY: Twenty-eight samples were used for toxicity testing. The 96-hour toxicity tests were conducted on an acute exposure basis, measuring survival of test organisms, *Hyalella azteca* and *Chrionomus dilutus*. Survival decreased to a statistically significant degree when compared to laboratory controls in 28% of tests on *H. azteca*, and in 7% of tests on *C. dilutus*.

- Below are pesticides recommended for the development analytical method from California Department of Food and Agriculture (CDFA) chemistry laboratory. This AI list was generated from the Surface Water Monitoring Prioritization Model (SWMP).

  None

2. Pesticide detection frequency

Data available in SURF upon yearly update. Contact Project Lead for data not yet uploaded. In SURF, use "SURF Study Number" (Section 1) for obtaining the data.

Table 1. Pesticide detection in water

Pesticide	Number of samples	Number of detections	Detection frequency (%)	Minimum Reporting Limit (µg/L)	Lowest USEPA benchmark (BM) (µg/L)[1]	BM Type[2]	Number of BM exceed-ances	BM exceedance frequency (%)
Abamectin	35	1	3	0.02	0.17	IA	0	0
Acetamiprid	29	2	7	0.02	2.1	IC	0	0
Atrazine	35	0	0	0.02	1	NVA	0	0
Azoxystrobin	35	27	77	0.02	44	IC	0	0
Benfluralin	4	0	0	0.05	1.9	FC	0	0

Pesticide	Number of samples	Number of detections	Detection frequenc (%)	Minimum Reporting Limit (µg/L)	Lowest benchmark BM) (µg/L)[1]	BM Type[2]	Number of BM exceed-ances	BM exceedance frequency (%)
Bensulide	35	1	3	0.02	11	IC	0	0
Bifenthrin	17	4	24	0.001	0.00005	IC	4	24
Boscalid	35	0	0	0.02	116	FC	0	0
Bromacil	35	0	0	0.02	6.8	NVA	0	0
Carbaryl	35	0	0	0.02	0.5	IC	0	0
Chlorantraniliprole	35	10	29	0.02	3.02	IC	0	0
Chlorfenapyr	4	0	0	0.1	2.915	IA	0	0
Chlorpyrifos	35	0	0	0.02	0.005	IC	0	0
Clothianidin	35	3	9	0.02	0.05	IC	2	6
Cyfluthrin	17	0	0	0.002	0.00012	IC	0	0
Cypermethrin	17	0	0	0.005	0.00005	IC	0	0
Cyprodinil	35	1	3	0.02	8.2	IC	0	0
Desulfinyl Fipronil	35	0	0	0.01	0.53	FC	0	0
Desulfinyl Fipronil Amide	35	0	0	0.01		(no BM)	0	0
Diazinon	35	0	0	0.02	0.105	IA	0	0
Diflubenzuron	35	0	0	0.02	0.00025	IC	0	0
Dimethoate	35	1	3	0.02	0.5	IC	0	0
Dinotefuran	30	1	3	0.02	6360	FC	0	0
Diuron	35	8	23	0.02	0.13	VA	1	3
Esfenvalerate/Fenvalerate	17	1	6	0.005	0.0000309	IC	1	6
Ethalfluralin	4	0	0	0.05	0.4	FC	0	0
Ethoprop	35	0	0	0.02	0.8	IC	0	0
Etofenprox	35	1	3	0.02	0.17	IC	0	0
Fenamidone	35	0	0	0.02	4.7	FC	0	0
Fenhexamid	35	0	0	0.02	101	FC	0	0
Fenpropathrin	17	1	6	0.002	0.0015	IC	1	6
Fipronil	35	1	3	0.01	0.011	IC	1	3
Fipronil Amide	35	0	0	0.01		(no BM)	0	0
Fipronil Sulfide	35	1	3	0.01		(no BM)	0	0
Fipronil Sulfone	35	1	3	0.01	0.22	IC	0	0
Fludioxonil	35	0	0	0.02	14	IC	0	0
Hexazinone	35	8	23	0.02	7	NVA	0	0
Imidacloprid	35	7	20	0.01	0.01	IC	9	26
Indoxacarb	35	1	3	0.02	75	IC	0	0
Isoxaben	35	0	0	0.02	10	VA	0	0
Kresoxim-methyl	35	0	0	0.02	30.3	NVA	0	0
Lambda Cyhalothrin	17	1	6	0.001	0.00004	IA	1	6
Malathion	35	0	0	0.02	0.049	IA	0	0

Pesticide	Number of samples	Number of detections	Detection frequenc (%)	Minimum Reporting Limit (µg/L)	Lowest USEPA benchmark (BM) (µg/L)[1]	BM Type[2]	Number of BM exceed-ances	BM exceedance frequency (%)
Mefenoxam	35	0	0	0.02	1200	IC	0	0
Methidathion	35	0	0	0.02	0.66	IC	0	0
Methomyl	35	3	9	0.02	0.6	IC	1	3
Methoxyfenozide	35	23	66	0.02	3.1	IC	0	0
Metribuzin	35	0	0	0.02	8.1	NVA	0	0
Norflurazon	35	0	0	0.02	6.03	NVA	0	0
Oryzalin	35	0	0	0.02	13	VA	0	0
Oxadiazon	35	1	3	0.02	0.88	FC	0	0
Oxyfluorfen	4	3	75	0.05	0.33	VA	1	25
Pendimethalin	4	1	25	0.05	5.2	NVA	0	0
Permethrin Total	17	0	0	0.001	0.0033	IA	0	0
Prodiamine	4	0	0	0.05	1.5	IC	0	0
Prometon	35	0	0	0.02	98	NVA	0	0
Prometryn	35	0	0	0.02	1.04	NVA	0	0
Propanil	35	3	9	0.02	2.4	FC	0	0
Propargite	35	1	3	0.02	7	IA	0	0
Propiconazole	35	12	34	0.02	15	FC	0	0
Pyraclostrobin	35	1	3	0.02	1.5	NVA	0	0
Pyriproxyfen	35	1	3	0.015	0.015	IC	1	3
Quinoxyfen	35	1	3	0.02	13	FC	0	0
Simazine	35	0	0	0.02	6	NVA	0	0
S-Metolachlor	35	5	14	0.02	8	NVA	0	0
Sulfoxaflor	33	0	0	0.02	660	FC	0	0
Tebuconazole	35	1	3	0.02	11	FC	0	0
Tebufenozide	35	0	0	0.02	29	IC	0	0
Tebuthiuron	35	0	0	0.02	50	NVA	0	0
Thiabendazole	35	0	0	0.02	42	IC	0	0
Thiacloprid	35	0	0	0.02	0.97	IC	3	8
Thiamethoxam	35	0	0	0.02	0.74	IC	2	5
Thiobencarb	35	13	37	0.02	1	IC	2	6
Trifloxystrobin	35	1	3	0.02	2.76	IC	0	0
Trifluralin	4	0	0	0.05	1.9	FC	0	0

[1] Benchmarks are used as a screening tool for risk analysis.

[2] FA, fish acute; FC, fish chronic; IA, invertebrate acute; IC, invertebrate chronic; NA, non-vascular acute; VA, vascular acute.

Table 2. Pesticide detection in sediment

Pesticide	Number of samples	Number of detections	Detection frequency (%)	LC_{50} (µg/kg OC)*	Detection frequency > LC_{50} (%)
Bifenthrin	3	1	33	520	33
Cyfluthrin	3	0	0	1080	0
Cypermethrin	3	0	0	380	0
Esfenvalerate/Fenvalerate	3	0	0	1540	0
Lambda Cyhalothrin	3	1	33	450	33
Permethrin	3	0	0	10830	0

*LC50 is derived from published values (from Amweg et al. 2005, Toxicol. Chem. 24:966-972; Amweg and D.P. Weston 2007, Environ. Toxicol. Chem. 26:2389-2396; Maund et al. 2002, Environ. Toxicol. Chem., 21:9-15).

3. Tracking Exceedances of Aquatic Benchmarks or Sediment LC_{50} values

For further data analysis: pesticides that have ≥ 10% BM exceedance rate or exceed their organic carbon (OC) normalized sediment LC_{50} for three consecutive years are recommended for further detailed data analysis if no analysis has been complete in the past five years (Ambient Urban Monitoring Methodology SOP METH014).

Table 3. Pesticides with three consecutive years of either 1) ≥ 10% of their detections exceeding their lowest BMs or 2) percentage of sediment detections exceeding their sediment LC_{50} (normalized to OC).

Pesticide	Matrix	Current year (2022)	2021	2020	Last written evaluation (reference)	Further data analysis (Y/N)
Bifenthrin	Water	25	32	24	NA	Y
Imidacloprid	Water	22	11	14	NA	Y
Oxyfluorfen	Water	33	11	13	NA	Y

4. Quality Control

Table 4. Laboratory Quality Control (QC) summary

QC Type	Sample Matrix	Total Number	Number of QC Out of Control
Lab Blank	Water	593	0
Matrix Spike	Water	593	1
Surrogate Spike	Water	80	3
Lab Blank	Sediment	9	0
Matrix Spike	Sediment	9	0

For this project, recoveries of the QC limits were set to be acceptable at a range of 70% to 120%. One matrix spike for carbaryl had a measured recovery outside of QC limits (59.8%). This matrix spike was associated with 6 samples for carbaryl. The measured concentrations of those samples may be underestimated due to the low recovery rates, although carbaryl was not detected in samples from this event, nor any other sampling events throughout 2022. Additionally, three surrogate spikes had recoveries outside of QC limits (atrazine-d5: 66.4%; imidacloprid-d4: 151.4%; imidacloprid-d4: 135.0%). These matrix spikes are associated with one analytical result, respectively. Although the recoveries of imidacloprid-d4 were above QC limits, imidacloprid was not detected in the respective samples. All lab blanks and matrix spikes for sediment were within QC limits.

5. Data: water quality, aquatic toxicity, and analytical chemistry results

Water quality data, aquatic toxicity data, and monitoring results are available upon request. Please contact the Project Lead or SURF database administrator for the data.