DEPARTMENT OF PESTICIDE REGULATION (DPR) Date: March 4, 2024

SURFACE WATER AMBIENT MONITORING REPORT

1. Study highlights

- DPR Study Number 321
- SURF (Surface Water Database) Study Number 91
- Study Title **Surface Water Monitoring for Pesticides in Agricultural Areas in the Central Coast and Southern California, 2022**
- Project Lead Pedro Lima, Ph.D.
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- Protocol Source (*protocol available online for five years, thereafter, request a copy from the SWPP list of archived files)* Environmental Monitoring Protocol Page

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- Study Area

  County: Imperial, Monterey, Santa Barbara, San Luis Obispo

  Waterbody/Watershed: Alamo River, New River, Oso Flaco Creek, Salinas River, Santa Maria River, Tembladero Slough

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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

- Objectives

  1. Determine occurrences (% detections) and measured chemical concentrations of pesticides in surface water and sediment collected from agricultural areas; 2. Compare environmental concentrations to the lowest US EPA (United States Environmental Protection Agency) aquatic life benchmarks; 3. Determine the toxicity of a subset of collected water samples to surrogate aquatic species in 96-hour (acute) or 10-day (chronic) water column testing.

- Sampling period January 2022 to December 2022

- Major findings

  INSECTICIDES IN WATER: Insecticides with detection frequencies (DF) > 50% were as follows: imidacloprid (96%), clothianidin (88%), chlorantraniliprole (86%), methoxyfenozide (80%),

thiamethoxam (65%), methomyl (61%), bifenthrin (59%), and acetamiprid (57%). Insecticides with DFs < 50% include: permethrin (47%), sulfoxaflor (47%), malathion (39%), lambda cyhalothrin (35%), dinotefuran (24%), fenpropathrin (16%), dimethoate (14%), and cypermethrin (12%). Cyfluthrin, abamectin, esfenvalerate/fenvalerate, carbaryl, indoxacarb, diflubenzuron, chlorfenapyr, and fipronil were detected infrequently with DFs ranging between 2 to 10%. Other insecticides were not detected in any samples collected during 2022. Concentrations of 10 insecticides surpassed their associated lowest US EPA aquatic life benchmarks (BMs) in more than 10% of the total samples collected. Active ingredients that exceeded their BM were imidacloprid (96%), clothianidin (76%), bifenthrin (59%), permethrin (37%), lambda cyhalothrin (35%), methomyl (25%), malathion (23%), fenpropathrin (16%), thiamethoxam (12%), and cypermethrin (12%). The BM exceedance frequencies for other insecticides were less than 10%.

HERBICIDES AND FUNGICIDES IN WATER: Herbicides with DFs ≥ 10% were triclopyr (100%), bensulide (63%), prometryn (51%), 2,4-D (50%), oxyfluorfen (37%), pendimethalin (35%), dicamba (33%), diuron (25%), and atrazine (14%). Other herbicides were detected infrequently with DFs <6%. Fungicides with DFs ≥ 10% were boscalid (75%), mefenoxam (58%), azoxystrobin (57%), propiconazole (47%), pyraclostrobin (35%), fludioxonil (24%), fenamidone (18%), cyprodinil (18%), and trifloxystrobin (18%). Other fungicides were detected infrequently with DFs < 10%. There were four herbicides and one fungicide with concentrations exceeding their lowest US EPA BMs: oxyfluorfen (10%), diuron (8%), prometryn (6%), pendimethalin (4%), and pyraclostrobin (4%).

PYRETHROIDS IN SEDIMENT: Sediment was collected from 16 monitoring sites in the Central Coast and Imperial Valley. All samples were analyzed for the presence of seven pyrethroids. Detection frequencies were as follows: bifenthrin (50%), permethrin (38%), lambda cyhalothrin (25%), fenpropathrin (13%), cyfluthrin (6%), cypermethrin (6%), and esfenvalerate/fenvalerate (6%).

TOXICITY: UC Davis Granite Canyon Marine Pollution Laboratory conducted 96-hr *Hyalella azteca* and 10-d *Chironomus dilutus* toxicity tests from 39 water samples collected from 14 monitoring locations. Samples were collected during the irrigation season and a storm event. Toxicity endpoints included survival (*Hyalella*, *Chironomus*) and growth (*Chironomus* only). Compared to laboratory controls, *Chironomus* survival was significantly reduced in 45% of tested surface water samples and *Hyalella* survival was significantly reduced in 59% of tested samples. Additionally, among 20 samples with survived organisms, *Chironomus* growth was significantly reduced in 45% of the samples.

- Recommendations for pesticides that need a CDFA (California Department of Food and Agriculture) analytical method (from Surface Water Protection Program Monitoring Prioritization Model, SWMP):

Linuron, PCNB (Pentachloronitrobenzene)

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 detections in water

Pesticide	Sample Number	Detection Number[1]	Detection frequency (%)	Minimum Reporting Limit (µg/L)	Lowest USEPA benchmark (BM) (µg/L)[1]	BM Type[2]	Number of BM exceedances	BM exceedance frequency (%)
2,4-D	12	6	50	0.05	299.2	VA	0	0
Abamectin	51	4	8	0.02	0.17	IA	0	0
Acetamiprid	51	29	57	0.02	2.1	IC	2	4
Atrazine	51	7	14	0.02	1	NA	0	0
Azoxystrobin	51	29	57	0.02	44	IC	0	0
Benfluralin	51	1	2	0.05	1.9	FC	0	0
Bensulide	51	32	63	0.02	11	IC	0	0
Bifenthrin	51	30	59	0.001	0.00005	IC	30	59
Boscalid	51	38	75	0.02	116	FC	0	0
Bromacil	51	0	0	0.02	6.8	NA	0	0
Carbaryl	51	3	6	0.02	0.5	IC	0	0
Chlorantraniliprole	51	44	86	0.02	3.02	IC	0	0
Chlorfenapyr	51	1	2	0.1	2.915	IA	0	0
Chlorpyrifos	51	0	0	0.02	0.005	IC	0	0
Clothianidin	51	45	88	0.02	0.05	IC	39	76
Cyfluthrin	51	5	10	0.002	0.00012	IC	5	10
Cypermethrin	51	6	12	0.005	0.00005	IC	6	12
Cyprodinil	51	9	18	0.02	8.2	IC	0	0
Desulfinyl Fipronil	51	0	0	0.01	0.53	FC	0	0
Desulfinyl Fipronil Amide	51	0	0	0.01		(no BM)	-	-
Diazinon	51	0	0	0.02	0.105	IA	0	0
Dicamba	12	4	33	0.05	61	NA	0	0
Diflubenzuron	51	2	4	0.02	0.00025	IC	2	4
Dimethoate	51	7	14	0.02	0.5	IC	1	2
Dinotefuran	51	12	24	0.02	6360	FC	0	0
Diuron	51	13	25	0.02	0.13	VA	4	8
Esfenvalerate/Fenvalerate	51	4	8	0.005	0.0000309	IC	4	8
Ethalfluralin	51	0	0	0.05	0.4	FC	0	0
Ethoprop	51	0	0	0.02	0.8	IC	0	0
Etofenprox	51	0	0	0.02	0.17	IC	0	0
Fenamidone	51	9	18	0.02	4.7	FC	0	0
Fenhexamid	45	5	11	0.02	101	FC	0	0
Fenpropathrin	51	8	16	0.005	0.0015	IC	8	16
Fipronil	51	1	2	0.01	0.011	IC	1	2
Fipronil Amide	51	0	0	0.01		(no BM)	-	-
Fipronil Sulfide	51	0	0	0.01		(no BM)	-	-
Fipronil Sulfone	51	1	2	0.01	0.22	IC	0	0
Fludioxonil	51	12	24	0.02	14	IC	0	0
Hexazinone	51	0	0	0.02	7	NA	0	0

Pesticide	Sample Number	Detection Number[1]	Detection frequency (%)	Minimum Reporting Limit (µg/L)	Lowest USEPA benchmark (BM) (µg/L)[1]	BM Type[2]	Number of BM exceedances	BM exceedance frequency (%)
Imidacloprid	51	49	96	0.01	0.01	IC	49	96
Indoxacarb	51	3	6	0.02	75	IC	0	0
Isoxaben	51	0	0	0.02	10	VA	0	0
Kresoxim-methyl	45	0	0	0.02	30.3	NA	0	0
Lambda Cyhalothrin	51	18	35	0.002	0.00004	IA	18	35
Malathion	51	20	39	0.02	0.049	IA	12	24
MCPA	12	0	0	0.05	170	VA	0	0
Mefenoxam	40	23	58	0.02	1200	IC	0	0
Methidathion	40	0	0	0.02	0.66	IC	0	0
Methomyl	51	31	61	0.02	0.6	IC	13	25
Methoxyfenozide	51	41	80	0.02	3.1	IC	1	2
Metribuzin	51	1	2	0.02	8.1	NA	0	0
Norflurazon	51	0	0	0.02	6.03	NA	0	0
Oryzalin	51	0	0	0.02	13	VA	0	0
Oxadiazon	51	1	2	0.02	0.88	FC	0	0
Oxyfluorfen	51	19	37	0.05	0.33	VA	5	10
Pendimethalin	51	18	35	0.05	5.2	NA	2	4
Permethrin Total	51	24	47	0.001	0.0033	IA	19	37
Prodiamine	51	0	0	0.05	1.5	IC	0	0
Prometon	51	0	0	0.02	98	NA	0	0
Prometryn	51	26	51	0.02	1.04	NA	3	6
Propanil	51	0	0	0.02	2.4	FC	0	0
Propargite	51	0	0	0.02	7	IA	0	0
Propiconazole	51	24	47	0.02	15	FC	0	0
Pyraclostrobin	51	18	35	0.02	1.5	NA	2	4
Pyriproxyfen	51	0	0	0.015	0.015	IC	0	0
Quinoxyfen	51	3	6	0.02	13	FC	0	0
Simazine	51	3	6	0.02	6	NA	0	0
S-Metolachlor	51	2	4	0.02	8	NA	0	0
Sulfoxaflor	51	24	47	0.02	660	FC	0	0
Tebuconazole	51	4	8	0.02	11	FC	0	0
Tebufenozide	51	0	0	0.02	29	IC	0	0
Tebuthiuron	51	0	0	0.02	50	NA	0	0
Thiabendazole	40	0	0	0.02	42	IC	0	0
Thiacloprid	51	0	0	0.02	0.97	IC	0	0
Thiamethoxam	51	33	65	0.02	0.74	IC	6	12
Thiobencarb	51	0	0	0.02	1	IC	0	0
Triclopyr	12	12	100	0.05	4200	NA	0	0
Trifloxystrobin	51	9	18	0.02	2.76	IC	0	0
Trifluralin	51	3	6	0.05	1.9	FC	0	0

[1] Benchmarks (BM) 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 detections in sediment

Pesticide	Sample Number	Detection Number	Detection frequency (%)	LC_{50} (µg/kg OC)*	Detection Frequency > LC_{50} (%)
Bifenthrin	16	8	50	520	38
Cyfluthrin	16	1	6	1,080	0
Cypermethrin	16	1	6	380	6
Esfenvalerate/Fenvalerate	16	1	6	1,540	0
Fenpropathrin	16	2	13	No Data	0
Lambda Cyhalothrin	16	4	25	450	13
Permethrin	16	6	38	10,830	0

*LC_{50} 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 LC50 values

For further data analysis: pesticides that have ≥ 10% aquatic benchmark exceedance rate or exceed their OC (organic Carbon) 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 USEPA aquatic life water benchmark 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	58	74	66	Deng et al. 2019	Y
Diuron	Water	8	15	13	Deng et al. 2019	N
Fenpropathrin	Water	15	16	0	Deng et al. 2019	N
Imidacloprid	Water	96	96	97	Deng et al. 2019	Y
Lambda Cyhalothrin	Water	35	48	25	Deng et al. 2019	Y
Malathion	Water	23	25	13	Deng et al. 2019	Y
Methomyl	Water	25	19	41	Deng et al. 2019	Y
Oxyfluorfen	Water	10	25	9	Deng et al. 2019	N
Permethrin	Water	37	49	31	Deng et al. 2019	Y
Thiamethoxam	Water	12	10	22	None	Y

4. Quality Control

Table 4. Laboratory Quality Control (QC) summary

QC Type	Sample Matrix	Total Number	Number of QC Out of Control
Blind Spike	Water	-	-
Laboratory Blank	Water	521	0
Matrix Spike	Water	539	5
Surrogate Spike	Water	208	28
Laboratory Blank	Sediment	18	0
Matrix Spike	Sediment	18	0

All laboratory blanks were within the QC limits. Five water matrix spikes for fenhexamid, kresoxim-methyl, mefenoxam, methidathion, and thiabendazole had recoveries below their QC limits. As a result, six water sample records of fenhexamid and kresoxim-methyl, and 11 water sample records of mefenoxam, methidathion, and thiabendazole, were excluded from the monitoring results in 2022. Matrix spikes for other analytes in water and sediment samples were within the 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.