DEPARTMENT OF PESTICIDE REGULATION (DPR)

SURFACE WATER AMBIENT MONITORING REPORT

Date: December 6, 2021

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, 2020**
- Project Lead Xin Deng, PhD.
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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: Monterey, Santa Barbara, San Luis Obispo

  Waterbody/Watershed: 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 Enter other type

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- 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 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 May 2020 to December 2020

INSECTICIDES IN WATER: Insecticides with detection frequencies (DF) > 50% were as follows: imidacloprid (97%), chlorantraniliprole (94%), thiamethoxam (88%), methoxyfenozide (75%), methomyl (72%), clothianidin (72%), and acetamiprid (53%). Insecticides with DFs < 50% include malathion (31%), and carbaryl (25%). Indoxacarb, esfenvalerate, dimethoate, and cypermethrin were detected infrequently with DFs ranging between 3 to 13%. Other insecticides were not detected in any samples collected during 2020. Bifenthrin (66%) was the most frequently detected pyrethroid followed by permethrin (50%), lambda cyhalothrin (25%) and cyfluthrin (22%). Eight insecticide concentrations surpassed the associated lowest US EPA aquatic life benchmarks (BMs). Their BM exceedance

frequencies were imidacloprid (97%), bifenthrin (66%), methomyl (41%), permethrin (31%), lambda cyhalothrin (25%), thiamethoxam (22%), cyfluthrin (22%), and malathion (13%). Concentrations of other 22 insecticides did not exceed the lowest US EPA BMs.

HERBICIDES AND FUNGICIDES IN WATER: Herbicides with DFs ≥ 50% were bensulide (81%), prometryn (72%), and bromacil (50%). Herbicides with DFs < 50% include oxyfluorfen (38%), diuron (25%), pendimethalin (6%), simazine (3%), and S-Metolachlor (3%). Other herbicides were not detected in any surface water samples in 2020. Fungicides with DFs ≥ 50% were boscalid (100%), azoxystrobin (75%), propiconazole (75%), and fenamidone (50%), mefenoxam (50%). Fungicides with DFs < 50% include pyraclostrobin (41%), cyprodinil (13%), fludioxonil (9%), quinoxyfen (9%), fenhexamid (3%), and trifloxystrobin (3%). Other fungicides were not detected in any surface water samples in 2020. There were four herbicides with concentrations exceeding their lowest US EPA BMs. Their BM exceedance frequencies were duiron (13%), prometryn (13%), oxyfluorfen (9%), and bensulide(3%).

PYRETHROIDS IN SEDIMENT: Sediment was collected from all 10 monitoring sites in the Central Coast. All samples were analyzed for the presence of seven pyrethroids. Detection frequencies were as follows: bifenthrin (90%), permethrin (90%), lambda cyhalothrin (60%), cyfluthrin (50%), esfenvalerate (40%), cypermethrin (20%), and fenpropathrin (10%).

STORMWATER SAMPLING: In 2020, four sites were further monitored during a mid-December storm event. DFs and US EPA BM exceedance frequencies of all the pesticides in storm samples were insignificantly deferent from those collected during the irrigation season. This was likely due to a weak storm event (< 0.75 inch precipitation) in the region. Nevertheless, DFs and BM exceedance frequencies were approximately two-fold higher in storm samples.

TOXICITY: UC Davis Granite Canyon Marine Pollution Laboratory conducted 96-hr *Hyalella azteca* and 10-d *Chironomus dilutus* toxicity tests from 15 water samples collected from 8 monitoring locations. All samples were collected during the irrigation season. Toxicity endpoints included survival (*Hyalella*, *Chironomus*) and growth (*Chironomus* only). Compared to laboratory controls, *Chironomus* survival was significantly reduced in 60% of surface water samples and *Hyalella* survival was significantly reduced in 47% of samples. In contrast, *Chironomus* growth was not significantly reduced in field water samples with survived organisms.

- Recommendations for pesticides that need a CDFA analytical method (from SWMP):

  Linuron, PCNB

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	Sample Number	Detection Number	Detection frequency (%)	Reporting Limit (µg/L)	Lowest USEPA benchmark (BM) (µg/L)[1]	BM Type[2]	Number of BM exceed-ances	BM exceedance frequency (%)
Abamectin	4	0	0	0.02	0.17	IA	0	0
Acetamiprid	32	17	53	0.02	2.1	IC	0	0

Pesticide	Sample Number	Detection Number	Detection frequency (%)	Reporting Limit (µg/L)	Lowest USEPA benchmark (BM) (µg/L)[1]	BM Type[2]	Number of BM exceed-ances	BM exceedance frequency (%)
Atrazine	32	0	0	0.02	1	NA	0	0
Azoxystrobin	32	24	75	0.02	44	IC	0	0
Benfluralin	32	1	3	0.05	1.9	FC	0	0
Bensulide	32	26	81	0.02	11	IC	1	3
Bifenthrin	32	21	66	0.001	0.00005	IC	21	66
Boscalid	4	4	100	0.02	116	FC	0	0
Bromacil	4	2	50	0.02	6.8	NA	0	0
Carbaryl	4	1	25	0.02	0.5	IC	0	0
Chlorantraniliprole	32	30	94	0.02	4.47	IC	0	0
Chlorfenapyr	22	0	0	0.1	2.915	IA	0	0
Chlorpyrifos	32	0	0	0.02	0.04	IC	0	0
Clothianidin[3]	32	23	72	-	0.05	IC	-	-
Cyfluthrin	32	7	22	0.002	0.00012	IC	7	22
Cypermethrin	32	2	6	0.005	0.00005	IC	2	6
Cyprodinil	32	4	13	0.02	8.2	IC	0	0
Desulfinyl Fipronil	4	0	0	0.01	0.54	FC	0	0
Desulfinyl Fipronil Amide	4	0	0	0.01		(no BM)	0	0
Diazinon	4	0	0	0.02	0.105	IA	0	0
Diflubenzuron	4	0	0	0.02	0.00025	IC	0	0
Dimethoate	32	1	3	0.02	0.5	IC	0	0
Diuron	32	8	25	0.02	0.13	NA	4	13
Esfenvalerate	32	1	3	0.005	0.0000309	IC	1	3
Ethalfluralin	32	0	0	0.05	0.4	FC	0	0
Ethoprop	4	0	0	0.02	0.8	IC	0	0
Etofenprox	4	0	0	0.02	0.17	IC	0	0
Fenamidone	32	16	50	0.02	4.7	FC	0	0
Fenhexamid	32	1	3	0.02	101	FC	0	0
Fenpropathrin	32	0	0	0.005	0.06	FC	0	0
Fipronil	4	0	0	0.01	0.011	IC	0	0
Fipronil Amide	4	0	0	0.01		(no BM)	0	0
Fipronil Sulfide	4	0	0	0.01	0.11	IC	0	0
Fipronil Sulfone	4	0	0	0.01	0.037	IC	0	0
Fludioxonil	32	3	9	0.02	14	IC	0	0
Hexazinone	4	0	0	0.02	7	NA	0	0
Imidacloprid	32	31	97	0.01	0.01	IC	31	97
Indoxacarb	32	4	13	0.02	75	IC	0	0
Isoxaben	4	0	0	0.02	10	VA	0	0
Kresoxim-methyl	4	0	0	0.02	30.3	NA	0	0
Lambda Cyhalothrin	32	8	25	0.002	0.00004	IC	8	25
Malathion	32	10	31	0.02	0.049	IA	4	13

Pesticide	Sample Number	Detection Number	Detection frequency (%)	Reporting Limit (µg/L)	Lowest USEPA benchmark (BM) (µg/L)[1]	BM Type[2]	Number of BM exceed-ances	BM exceedance frequency (%)
Mefenoxam	4	2	50	0.02	1200	IC	0	0
Methidathion	4	0	0	0.02	0.66	IC	0	0
Methomyl	32	23	72	0.02	0.6	IC	13	41
Methoxyfenozide	32	24	75	0.02	3.1	IC	0	0
Metribuzin	4	0	0	0.02	8.1	NA	0	0
Norflurazon	4	0	0	0.02	9.7	NA	0	0
Oryzalin	4	0	0	0.02	13	VA	0	0
Oxadiazon	4	0	0	0.02	5.2	NA	0	0
Oxyfluorfen	32	12	38	0.05	0.29	NA	3	9
Pendimethalin	32	2	6	0.05	5.2	NA	0	0
Permethrin	32	16	50	0.001	0.0033	IC	10	31
Prodiamine	32	0	0	0.05	1.5	IC	0	0
Prometon	4	0	0	0.02	98	NA	0	0
Prometryn	32	23	72	0.02	1.04	NA	4	13
Propanil	4	0	0	0.02	9.1	FC	0	0
Propargite	4	0	0	0.02	7	IA	0	0
Propiconazole	4	3	75	0.02	21	NVA	0	0
Pyraclostrobin	32	13	41	0.02	1.5	NVA	0	0
Pyriproxyfen	4	0	0	0.015	0.015	IC	0	0
Quinoxyfen	32	3	9	0.02	13	FC	0	0
Simazine	32	1	3	0.02	6	NA	0	0
S-Metolachlor	32	1	3	0.02	8	NA	0	0
Tebuconazole	4	0	0	0.02	11	FC	0	0
Tebufenozide	4	0	0	0.02	29	IC	0	0
Tebuthiuron	4	0	0	0.02	50	NA	0	0
Thiabendazole	4	0	0	0.02	42	IC	0	0
Thiacloprid	4	0	0	0.02	0.97	IC	0	0
Thiamethoxam	32	28	88	0.02	0.74	IC	7	22
Thiobencarb	4	0	0	0.02	1	IC	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; NVA, non-vascular acute; VA, vascular acute

[3] Clothianidin detections are qualitative only

Table 2. Pesticide detection in sediment

Pesticide	Sample Number	Detection Number	Detection frequency (%)	LC_{50} (µg/g OC)*	Detection frequency (%) of sediments ≥ 1 TU*	Median TUs*
Bifenthrin	10	9	90	0.52	NA	NA
Cyfluthrin	10	5	50	1.08	NA	NA
Cypermethrin	10	2	20	0.38	NA	NA

Pesticide	Sample Number	Detection Number	Detection frequency (%)	LC_{50} (µg/g OC)*	Detection frequency (%) of sediments ≥ 1 TU*	Median TUs*
Esfenvalerate	10	4	40	1.54	NA	NA
Fenpropathrin	10	1	10	1.60	NA	NA
Lambda Cyhalothrin	10	6	60	0.45	NA	NA
Permethrin	10	9	90	10.83	NA	NA

*Sediment Toxicity Units (TUs) are calculated using the formula, use TU = C/1000/LC50 / % TOC, where C = concentration (µg/kg dry weight), LC50 (µg/kg) is derived from accepted 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). One TU is equal to the LC50. Due to technical issues with the TOC/DOC machine, we were unable to measure % TOC in sediments and calculate OC-normalized concentrations to compare with published LC50 values. Therefore, TU calculations were currently unavailable.

3. Tracking Benchmark Exceedances (BME) or Sediment Toxicity (TU)

For further data analysis: pesticides that have ≥ 10% aquatic benchmark exceedances [BME] or ≥ 1 sediment toxicity units [TU] for 3 consecutive years are recommended for further detailed data analysis (Ambient Urban Monitoring Methodology SOP METH014).

Table 3. BME (for pesticides with ≥ 10% BME) or median sediment TUs (for pesticides with ≥ 1 sediment TU) (all sites) for the past 3 years

Pesticide	Matrix	Current year (2020)	2019	2018	Last written evaluation (reference)	Further data analysis (Y/N)
Bifenthrin	Water	66	31	28	Deng et al. 2019	Y
Imidacloprid	Water	97	98	94	Deng et al. 2019	Y
Lambda Cyhalothrin	Water	25	31	28	Deng et al. 2019	Y
Malathion	Water	13	21	18	Deng et al. 2019	Y
Methomyl	Water	41	31	16	Deng et al. 2019	Y
Permethrin	Water	31	34	20	Deng et al. 2019	Y
Prometryn	Water	13	2	6	Deng et al. 2019	N
Thiamethoxam	Water	22	14	NA	None	N
Bifenthrin	Sediment	NA	19	12.5	None	-
Lambda Cyhalothrin	Sediment	NA	25	12.5	None	-

4. Quality Control

Table 4. Laboratory Quality Control (QC) summary

QC Type	Water	Samples	Sediment	Samples
	Total Number	Number of QC out of control	Total Number	Number of QC out of control
Lab Blanks	77	0	9	0

QC Type	Water	Samples	Sediment	Samples
Matrix Spikes/Duplicates	75	25	9	0
Blind Spikes	5	0	0	0
Surrogate Spikes	64	0	0	0

All lab blanks, blind spikes, and surrogate spikes were within the QC limits. Matrix spikes of 25 pesticides in LC screen were out of the QC control range. The lab estimated 20-25% higher than usual due to a prolonged storage period in the refrigerator. Analytical results for 10 samples associated with the matrix spikes were included in this report without any changes, and flagged in the monitoring result datasheet, which is available upon request.

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.