NJ Department of Environmental Protection
Pesticide Compliance & Enforcement
Pesticide Evaluation & Monitoring

APPLE ORCHARD SURFACE WATER MONITORING 2015

Background

Routine monitoring of surface waters for pesticides is undertaken every year to proactively search out any possible discharge of residues to non-target water bodies in New Jersey. Surface water draining from apple orchards was chosen as the focus for our 2015 spring/summer monitoring. A study by Rutgers University is looking at the possible connection between pyrethrin insecticides and ADHD in children. Apple orchards were chosen because of the use of pyrethrins in that agricultural area. Approximately 52,000 pounds of active ingredient (ai.) are applied in NJ's apple orchards annually. That is 5.3% of the total ai. applied (97,800 pounds) state wide according to the 2012 NJDEP Private Applicator Pesticide Use Survey.

Field Sampling Procedures

The Pesticide Evaluation & Monitoring Section (PEMs) of the Pesticide Control Program (PCP) obtained a list of apple growers from the Jersey Fresh website (www.jerseyfresh.nj.gov). Annual production amounts and down-stream, road-side accessibility were used to identify five sites. All five sites had a sampling procedure in place to collect run-off from the apple orchards. The site locations are as follows:

County	Township
Mercer	Lawrence
Morris	Chester (2 sites)
Gloucester	Franklin
Monmouth	Freehold

PEMs sampled these five sites monthly from April to September. A grab sample was collected at each site using a polyethylene "dipper" and transferred to a certified clean 950ml amber class bottle. The dipper was thoroughly rinsed between samples using deionized water. Water quality measurements (dissolved oxygen, turbidity, conductivity, pH and temperature) were also noted for each sample collected. Two sites (Mercer and Gloucester) had detections during all five sampling events, and were sampled a sixth time in October due to the previous detections. The samples were held in chilled coolers during transport to the PCP pesticide laboratory and immediately placed in refrigerators. Samples were submitted for GCMS pesticide scan analysis.

Sample Results

Four different herbicides and one insecticide were detected throughout the growing season for a total of 20 detections across all sites during the sixth month sampling period. All detections were below the EPA's life-time Health Advisory Level (HAL). Metolachlor was the most frequently detected herbicide (12 detections) with levels ranging from <0.2 to 0.48 µg/l. The highest level of metolachlor detected is far below the 100 µg/l EPA Life-Time HAL (Table 1). The highest level of metolachlor detected (0.48 µg/l) is nearly 50% of the chronic benchmark for aquatic invertebrates (1 µg/l) (Table 2).

There were 4 detections of terbacil ranging from 0.21 to 1.8 µg/l. The highest level of terbacil detected is far below the 90 µg/l EPA Life-Time HAL (Table 1). Atrazine, norflurazon and methoxychlor (insecticide) were also detected at trace levels through the growing season. The highest level of methoxychlor (<0.2 µg/l) is nearly 30% of the acute benchmark for aquatic invertebrates (Table 2).

Table 1. 2015 Apple Orchard Surface Water

Van Kirk Road, Lawrence Township, Mercer County

Date Collected	Field ID	Lab ID	Detections	µg/l	EPA DW Standard (MCL)	Reference Levels (RL) µg/l EPA HAL (Life-time)	NJ Interim Generic GW Quality SOC
4/21/2015	AO2-2015	SW1503	Metolachlor	0.48		100	
			Terbacil	1.8		90	
5/26/2015	AO8-2015	SW1516	Metolachlor	0.23		100	
6/30/2015	AO13-2015	SW1525	Atrazine	<0.2	3		
			Metolachlor	0.2		100	
			Norflurazon	<0.4			100
			Terbacil	0.34		90	
7/29/2015	AO18-2015	SW1538	Metolachlor	0.2		100	
8/25/2015	AO23-2015	SW1547	Metolachlor	0.27		100	
			Terbacil	0.28		90	
10/6/2015	AO27-2015	SW1559	Metolachlor	<0.2		100	

Willow Grove Road, Franklin Township, Gloucester County

Date Collected	Field ID	Lab ID	Detections	µg/l	EPA DW Standard (MCL)	Reference Levels (RL) µg/l EPA HAL (Life-time)	NJ Interim Generic GW Quality SOC
4/29/2015	AO5-2015	SW1511	Metolachlor	<0.2		100	
5/26/2015	AO6-2015	SW1514	Metolachlor	<0.2		100	
6/30/2015	AO11-2015	SW1523	Atrazine	0.31	3		
			Metolachlor	0.32		100	
7/29/2015	AO16-2015	SW1536	Metolachlor	<0.2		100	
8/25/2015	AO21-205	SW1545	Metolachlor	<0.2		100	
			Terbacil	0.21		90	
10/6/2015	AO26-2015	SW1557	None Detected	--			

State Park Road, Chester Township, Morris County

Date Collected	Field ID	Lab ID	Detections	µg/l	EPA DW Standard (MCL)	Reference Levels (RL) µg/l EPA HAL (Life-time)	NJ Interim Generic GW Quality SOC
4/23/2015	AO4-2015	SW1509	None	--			
5/28/2015	AO10-2015	SW1518	Metolachlor	<0.2		100	
7/2/2015	AO15-2015	SW1530	Methoxychlor	<0.2	40		
7/30/2015	AO20-2015	SW1543	None	--			
8/26/2015	AO25-2015	SW1551	None	--			

Table 1. 2015 Apple Orchard Surface Water (cont.)

Wemrock Road, Freehold Township, Monmouth County

Date Collected	Field ID	Lab ID	Detections	µg/l	Reference Levels (RL) µg/l EPA DW Standard (MCL)	EPA HAL (Life-time)	NJ Interim Generic GW Quality SOC
4/21/2015	AO1-2015	SW1502	None	--			
5/29/2015	AO7-2015	SW1515	None	--			
6/30/2015	AO12-2015	SW1524	None	--			
7/29/2015	AO17-2015	SW1537	None	--			
8/25/2015	AO22-2015	SW1546	None	--			

Furnace Road, Chester Township, Morris County

Date Collected	Field ID	Lab ID	Detections	µg/l	Reference Levels (RL) µg/l EPA DW Standard (MCL)	EPA HAL (Life-time)	NJ Interim Generic GW Quality SOC
4/23/2015	AO3-2015	SW1508	None	--			
5/28/2015	AO9-2015	SW1517	None	--			
7/2/2015	AO14-2015	SW1529	None	--			
7/30/2015	AO19-2015	SW1542	None	--			
8/26/2015	AO24-2015	SW1550	None	--			

Table 2. Freshwater Aquatic Life Benchmarks

	Highest Conc. Detected (µg/l)	Fish Acute[1] Level (µg/l)	Fish Chronic[2] Level (µg/l)	Invertebrates Acute[3] Level (µg/l)	Invertebrates Chronic[4] Level (µg/l)
Metolachlor	0.48	1600	30	550	1
Norfurazon	< 0.4	4050	770	> 7500	1000
Terbacil	0.34	23100	1200	32500	640
Atrazine	< 0.2	2650		360	60
Methoxychlor	<0.2	7.5		0.7	

[1] = Lowest 96 hour LC50 in a standardized test (usually with rainbow trout, fathead minnow, or bluegill), and the LOC is 0.5.

[2] = Lowest NOAEC from a life-cycle or early stage test (usually with rainbow trout, fathead minnow), and the LOC is 1.

[3] = Lowest 48 or 96 hour EC50 or LC50 in a standardized test (usually with midge, scud, or daphnids), and the LOC is 0.5.

[4] = Lowest NOAEC from a life-cycle test with invertebrates (usually with midge, scud, or daphnids), and the LOC is 1.

NOAEC = no-observed-adverse-effects concentration
LOC = level of concern
EC50 = 50 percent effect concentration
LC50 = 50 percent lethal concentration

The values in Table 2 were extracted directly from the following website: https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/aquatic-life-benchmarks-pesticide-registration.

Summary

The water sampled during this project was surface water, not ground water. While the guidelines referenced in Table 1 apply to drinking water and ground water, they provide an additional reference point when conducting an overall aquatic assessment. The aquatic life benchmarks provided in Table 2 provide the best assessment tool for this surface water project. Aquatic life benchmarks were established by the EPA's Office of Pesticide Programs and Office of Water. Comparing a measured concentration of a pesticide in water with an aquatic life benchmark can be helpful when interpreting monitoring data, and to identify and prioritize sites and pesticides that may require further investigation. The highest level of metolachlor detected (0.48 µg/l) is nearly 50% of the chronic benchmark for aquatic invertebrates (1 µg/l). The highest level of methoxychlor (<0.2 µg/l) is nearly 30% of the acute benchmark for aquatic invertebrates. These percentages raise some concern regarding the health of the aquatic life in the stream where the detections occurred, most notably because invertebrates are at the bottom of the food web. Low level pesticide detections in surface water may not have a direct impact on human health, but impacts to aquatic microorganisms can have effects on higher level consumers. A full stream health assessment would help identify impacts from these detections. PEMs recommends that aquatic life benchmarks become part of the data assessment tools during future surface water monitoring projects.

Citations

"Standard Operation Procedure: Collection of Pesticide Samples." NJDEP, Pesticide Control Program. (2007).

USEPA. Aquatic Life Benchmarks for Pesticide Registration. Retrieved from https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/aquatic-life-benchmarks-pesticide-registration.