

***Evaluation of
Neonicotinoid Seed
Treatments in the
Environment***



Neonicotinoids

- ❖ **Modeled after Nicotine**
- ❖ **Low mammalian toxicity**
- ❖ **Systemic insecticides**
 - Neonicotinoid taken up by plant or crop
 - Insect feeds on plant
 - Causes insect paralysis which leads to death
- ❖ **Much concern over the impact of these pesticides on pollinators**



- ❖ **Agency research = evaluate potential impacts of seed treatments in the environment**
 - Pollen
 - Surface waters
 - Tile drains
 - Soil
 - Vegetation

Neonicotinoids in Vermont

- ❖ One way neonicotinoids enter the state is as seed treatments on corn and soybeans
- ❖ Neonicotinoids used as seed treatments
 - Corn = thiamethoxam and clothianidin
 - Soybean = imidacloprid
- ❖ Purpose = protect seeds and seedlings from insect pests; wireworms & grubs
- ❖ Pollen and nectar could contain neonicotinoids from treated crop

Estimated annual acreage of treated seed planted in Vermont (2018)

- ❖ 100,000 – 120,000 acres of corn
 - ❖ 7,500 – 10,000 acres of soybeans
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- ❖ Treatments may not be completely taken up by plant and may enter the environment; soil, water, & non-target plants

Environmental Benchmarks

- ❖ Part Per Billion (PPB) = 1 cent in \$10,000,000 or 1 second in 32 years
- ❖ Aquatic invertebrate values = Most conservative (restrictive)
 - Used as comparison in water results
- ❖ Aquatic invertebrate values = Most closely related to terrestrial insects
- ❖ Note: Thiamethoxam degrades into Clothianidin

Environmental benchmarks in parts per billion (ppb)

Pesticide	Year Updated	Fish		Aquatic Invertebrates		Nonvascular Plants	Vascular Plants
		<i>Acute</i>	<i>Chronic</i>	<i>Acute</i>	<i>Chronic</i>	<i>Acute</i>	<i>Acute</i>
Imidacloprid	2017	114500	9000	0.385	0.01	> 10000	-
Thiamethoxam	2017	> 50000	20000	17.5	-	> 97000	> 90000
Clothianidin	2016	> 50750	9700	11.0	1.1	64000	121000

*All units ug/L or parts per billion (ppb); data extracted 1/2018 and 11/2018

Vermont Pollen Studies

Samples collected 2012 - 2013

- ❖ Honey Bee Pollen - 2 Hives
 - Hay fields (Hive 1)
 - Conventional corn fields* (Hive 2)



Results:

- ❖ 2012-2013 Hive 1
 - No neonicotinoids
- ❖ 2012-Hive 2
 - Imidacloprid (0.70 ppb), week of 11-Jun 2012.
- ❖ 2013-Hive 2
 - 3 detections; thiamethoxam and clothianidin (0.80-6.20 ppb)
 - During planting

Vermont Surface Water

❖ 2014 - 2018: 252 surface waters tested

- Areas of high agricultural use
- 3 positive for imidacloprid
 - All below acute benchmark
- More detections thiamethoxam and clothianidin
 - Usually at time of planting



A surface water sampling site.

Summary of neonicotinoid results from the surface water samples.

Neonicotinoid	Positive detection	Detection range	Acute benchmark*	Chronic benchmark*	Results \geq Acute benchmark*
	#	ppb	ppb	ppb	#
Thiamethoxam	26	0.05 - 1.73	17.50	-	0
Clothianidin	25	0.05 - 1.37	11.00	1.10	0
Imidacloprid	3	0.05 - 0.20	0.385	0.01	0

*aquatic invertebrates

← NO ACUTE

Vermont Tile Drain Water



Tile drain sampling location.

Tile drain = water from edge of field

❖ 2015-2018: 78 samples

- Imidacloprid = 4 samples \geq acute benchmark
-Soybean fields
- Highest levels = during planting

Summary of neonicotinoid results from the tile drain water samples.

Neonicotinoid	Positive detection	Detection range	Acute benchmark*	Chronic benchmark*	Results \geq Acute benchmark*
	#	ppb	ppb	ppb	#
Thiamethoxam	29	0.05 - 1.31	17.50	-	0
Clothianidin	61	0.05 - 4.17	11.00	1.10	0
Imidacloprid	12	0.09 - 1.12	0.385	0.01	4

← NO ACUTE

*aquatic invertebrates

Vermont Soil

2016 Sampling

- ❖ High agricultural use; corn, soy/corn, soy/soy, & alfalfa/grass
- ❖ Three dates; June, September, & December
- ❖ Three depths; 0-12, 12-24, & 24-36 inches
- ❖ Next to tile drains.

Results

- ❖ Corn fields = several positive detections of thiamethoxam & clothianidin (2.08 -14.13 ppb)
 - Most during planting (June)
 - 0 – 12 inches
- ❖ Soy field = positive detection of imidacloprid (6.43 ppb)
 - 0 - 12 inches

Vermont Vegetation

Question: Are neonicotinoids being taken up by non-crop plants?

❖ Sampling:

- September 2015 & 2016
- Vegetation collected from surface and tile drain water sampling areas in Franklin county
- Goldenrod = forage source for pollinators-later season
- Positive control = corn leaves from treated seed
- Corn leaves **only** positive detection
 - Clothianidin (2.91 ppb)



A vegetation sample taken from water sampling areas

New York Subsurface and Surface Water, (2017-2018)

- ❖ Collaboration with Miner Institute, Chazy, NY
- ❖ Samples from edge-of-field research project
 - Comparing subsurface tile and surface water
 - Fields - continuous corn
 - Seed treated with neonicotinoids

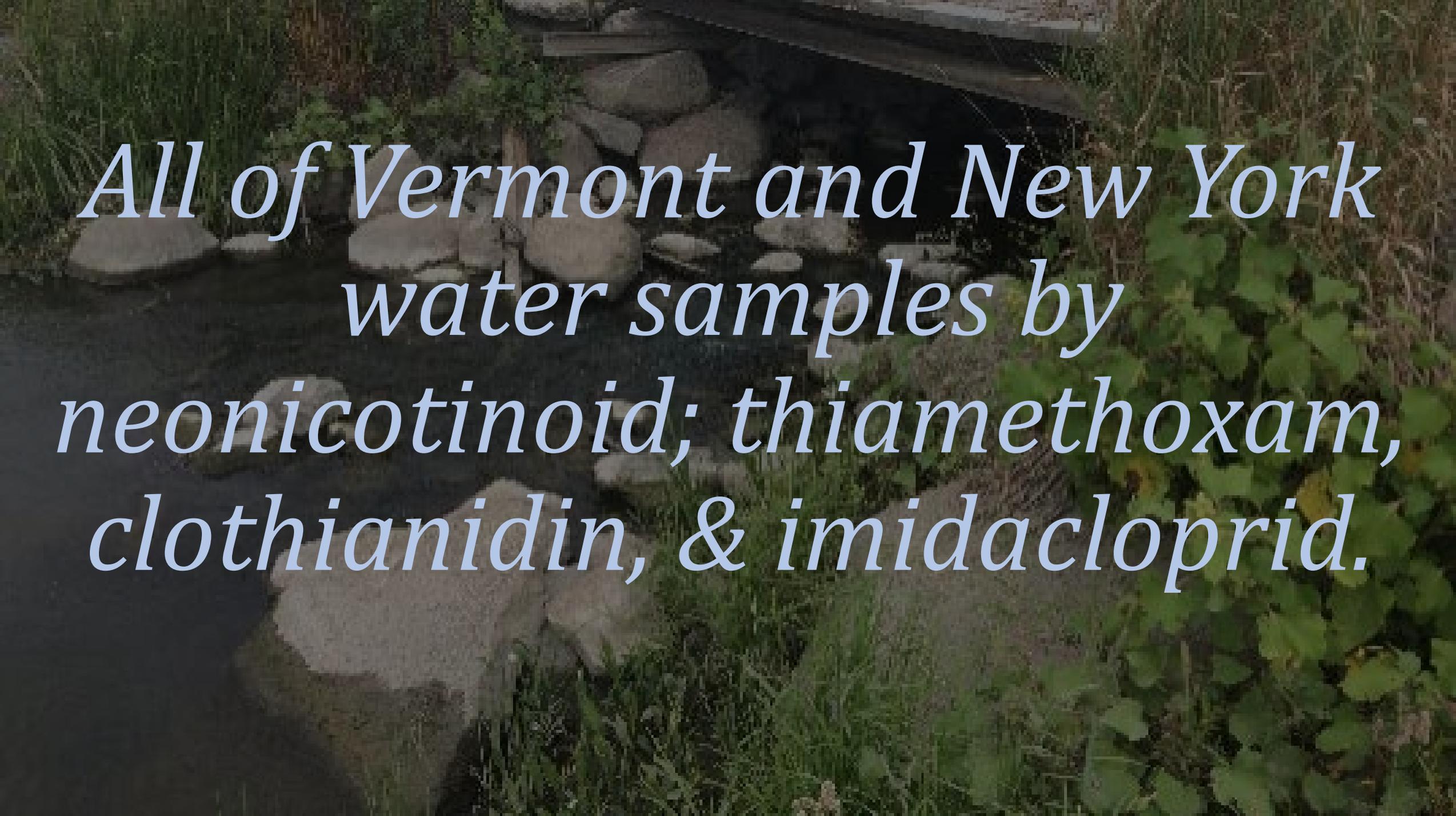
Results

- ❖ 128 samples analyzed
- ❖ 27 positive detections total
 - Thiamethoxam (0.06-6.48)
 - Clothianidin (0.08-0.40)
 - No imidacloprid
- ❖ Highest detections;
 - Surface water
 - All below acute benchmark
 - During and right after planting

Summary results from the subsurface and surface water samples analyzed for neonicotinoids, Chazy, NY, 2017-2018. (n=128)

Neonicotinoid	Positive detection	Detection range	Acute benchmark*	Chronic benchmark*	Results ≥ Acute benchmark*
	#	ppb	ppb	ppb	#
Thiamethoxam	25	0.06 - 6.48	17.50	-	0
Clothianidin	13	0.08 - 0.40	11.00	1.10	0
Imidacloprid	0	<0.05	0.385	0.01	0

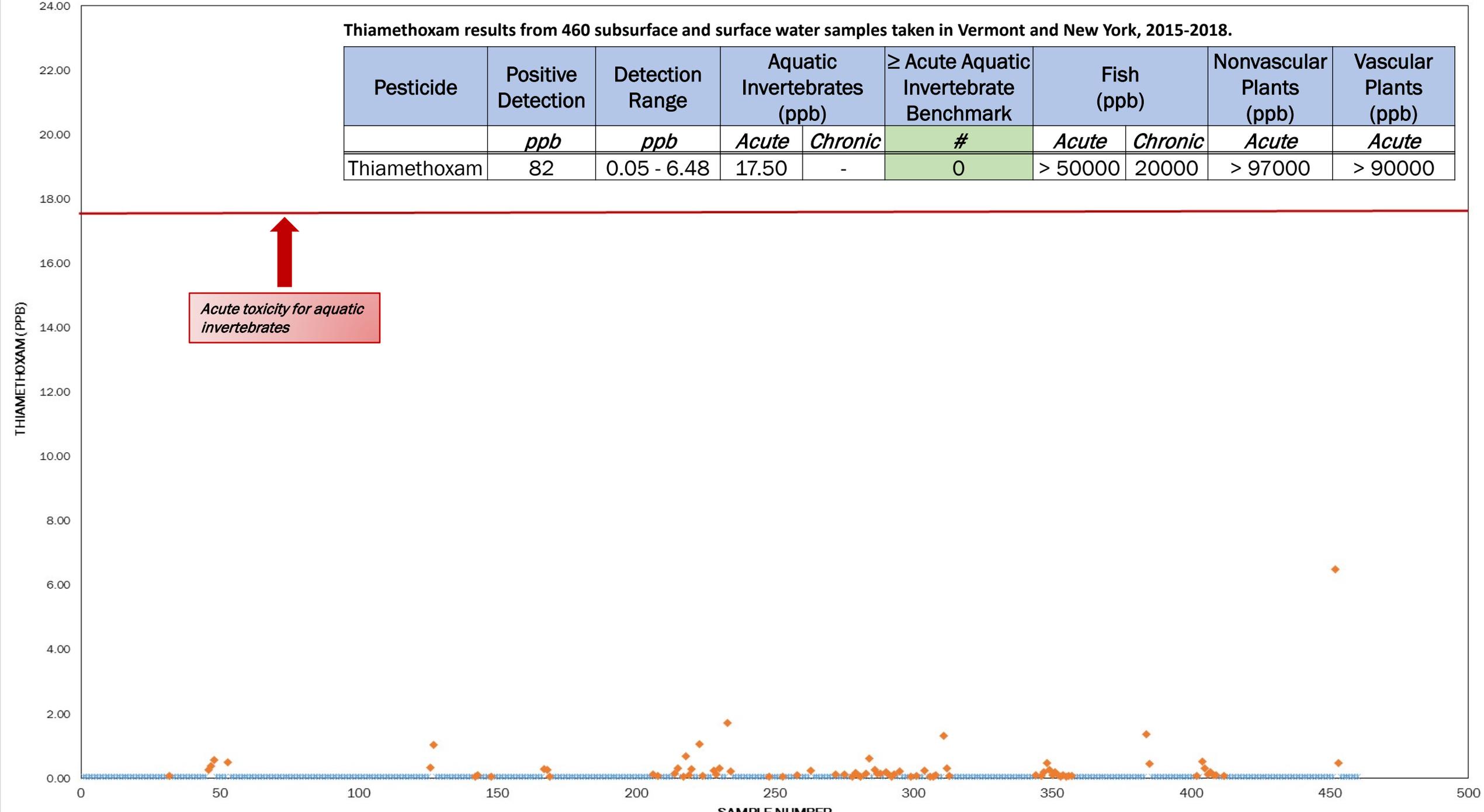
*aquatic invertebrates

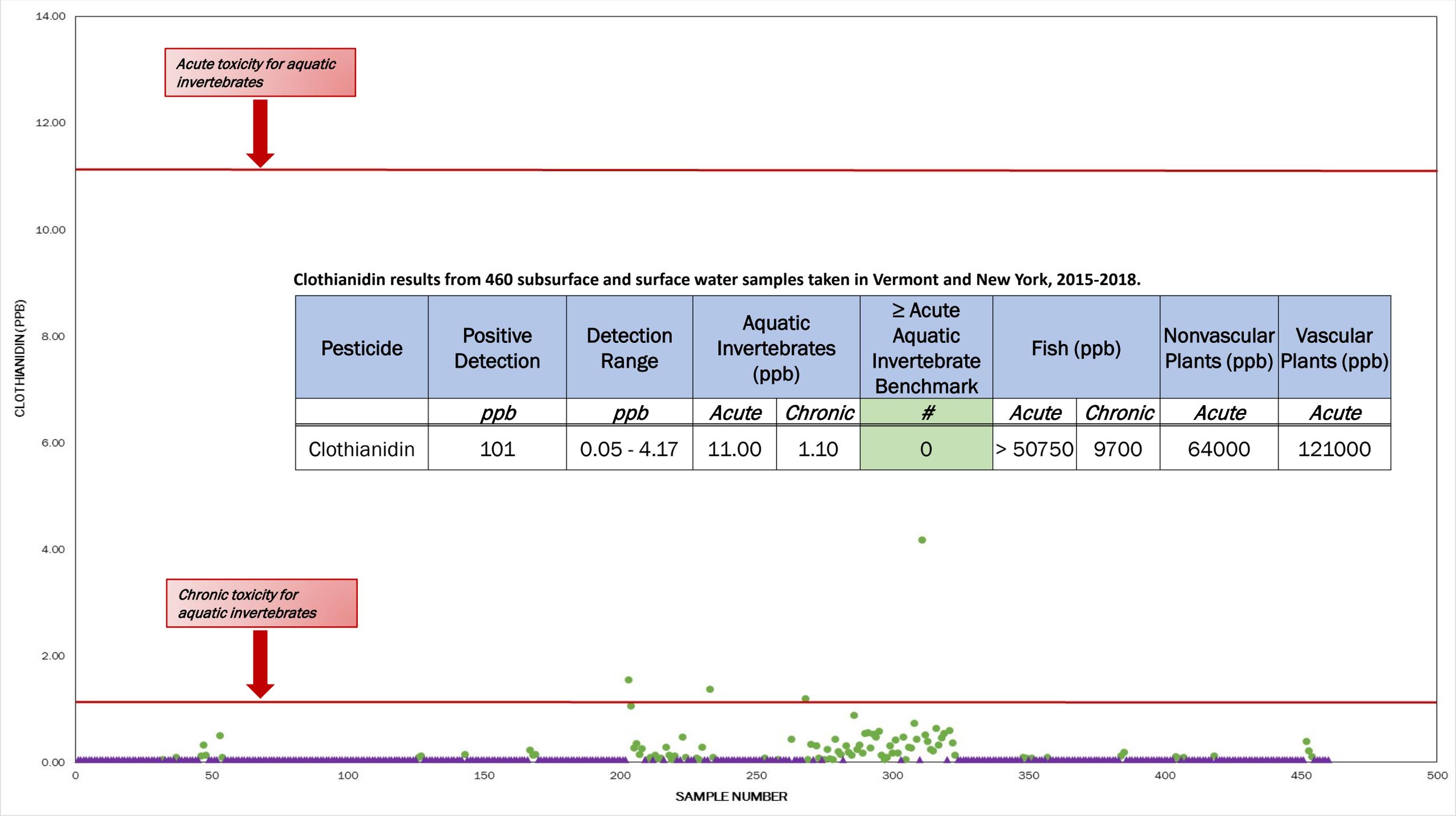
A photograph of a small stream with a stone-lined bank, surrounded by green grass and foliage. The text is overlaid on the image in a white, italicized serif font.

*All of Vermont and New York
water samples by
neonicotinoid; thiamethoxam,
clothianidin, & imidacloprid.*

Thiamethoxam results from 460 subsurface and surface water samples taken in Vermont and New York, 2015-2018.

Pesticide	Positive Detection	Detection Range	Aquatic Invertebrates (ppb)		≥ Acute Aquatic Invertebrate Benchmark	Fish (ppb)		Nonvascular Plants (ppb)	Vascular Plants (ppb)
			Acute	Chronic		Acute	Chronic		
Thiamethoxam	82	0.05 - 6.48	17.50	-	0	> 50000	20000	> 97000	> 90000





Acute toxicity for aquatic invertebrates



Clothianidin results from 460 subsurface and surface water samples taken in Vermont and New York, 2015-2018.

Pesticide	Positive Detection	Detection Range	Aquatic Invertebrates (ppb)		≥ Acute Aquatic Invertebrate Benchmark	Fish (ppb)		Nonvascular Plants (ppb)	Vascular Plants (ppb)
			<i>Acute</i>	<i>Chronic</i>	#	<i>Acute</i>	<i>Chronic</i>	<i>Acute</i>	<i>Acute</i>
Clothianidin	101	0.05 - 4.17	11.00	1.10	0	> 50750	9700	64000	121000

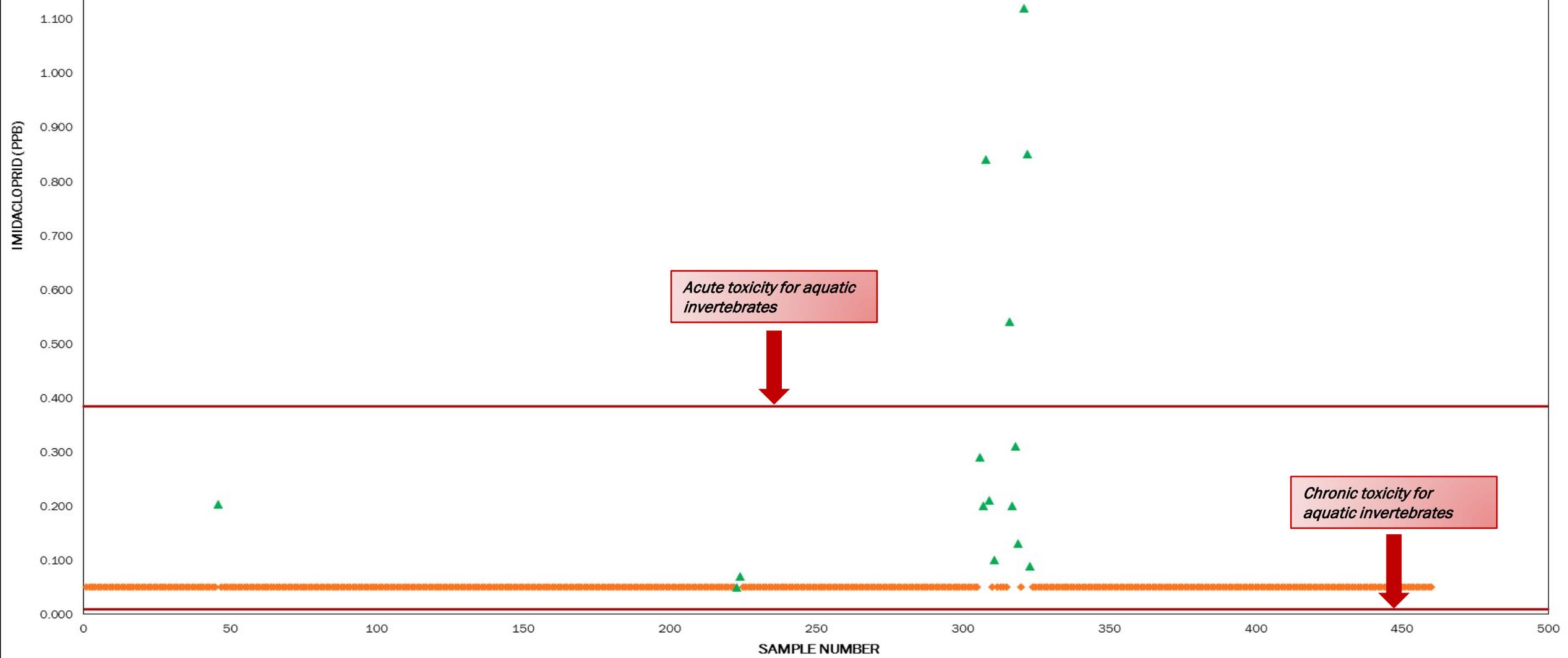
Chronic toxicity for aquatic invertebrates



SAMPLE NUMBER

Imidacloprid results from 460 subsurface and surface water samples taken in Vermont and New York, 2015-2018.

Pesticide	Positive Detection	Detection Range	Aquatic Invertebrates (ppb)		≥ Acute Aquatic Invertebrate Benchmark	Fish (ppb)		Nonvascular Plants (ppb)	Vascular Plants (ppb)
	<i>ppb</i>	<i>ppb</i>	<i>Acute</i>	<i>Chronic</i>	#	<i>Acute</i>	<i>Chronic</i>	<i>Acute</i>	<i>Acute</i>
Imidacloprid	15	<0.05 - 1.12	0.385	0.01	4	114500	9000	> 10000	-



Acute toxicity for aquatic invertebrates

Chronic toxicity for aquatic invertebrates



**Working with
UVM Extension
to draft BMPs
for using
neonicotinoid
treated seed**