VT Pollinator Health & Pesticide Monitoring

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The views expressed are my own and do not imply endorsement by the University.

VERMONT BEE LAB

The University of Vermont

Introductions

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Jeffords Building, Room 220

Photo: Joshua Brown

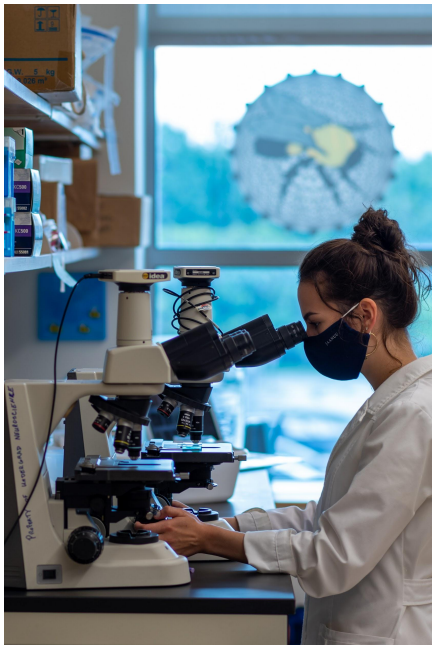
Education

Diagnostic Services

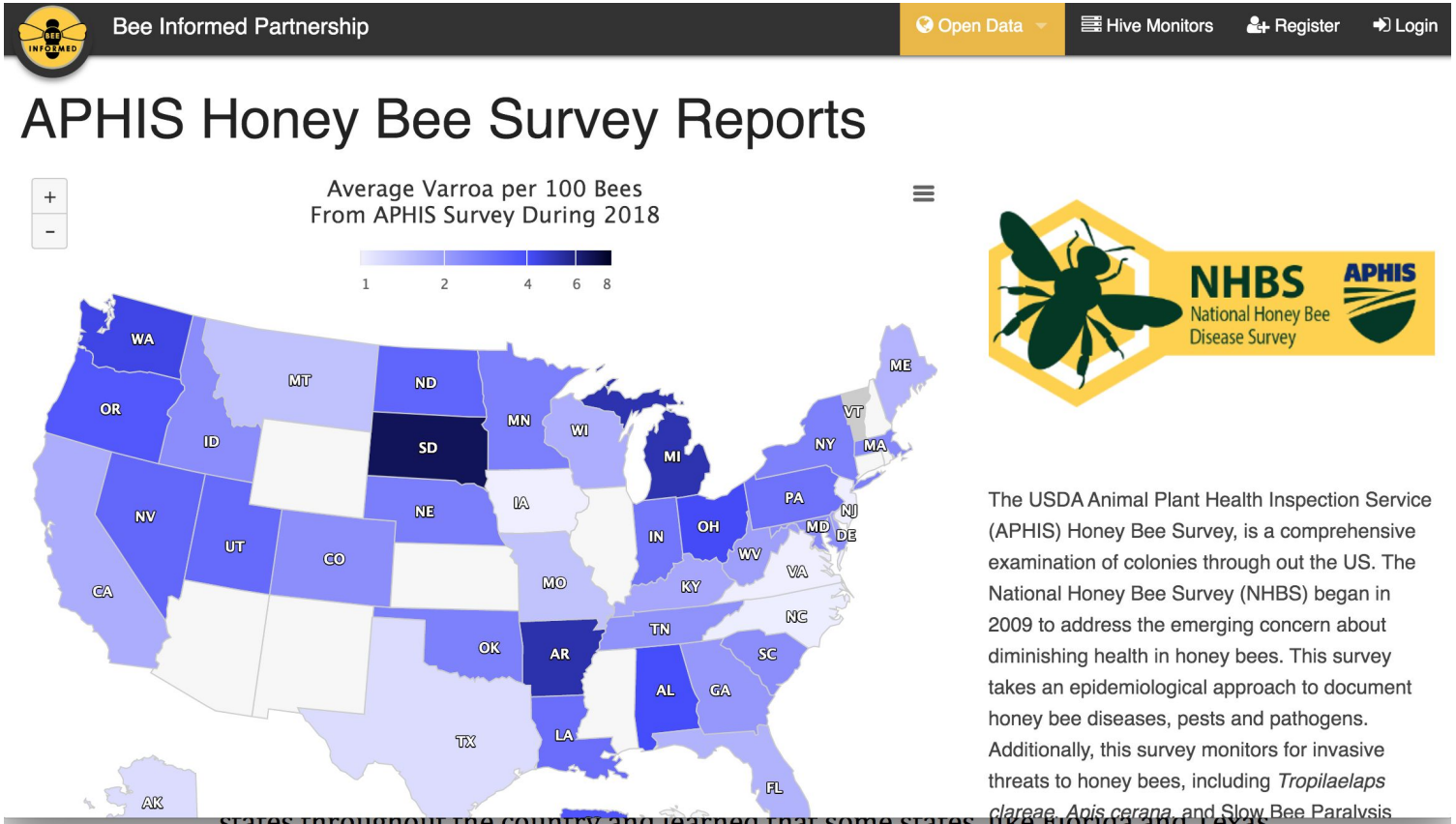
VERMONT
AGENCY OF AGRICULTURE, FOOD & MARKETS

VERMONT SPECIALTY CROP
BLOCK GRANT PROGRAM

VERMONT BEEKEEPERS ASSOCIATION
SINCE 1886



National Honey Bee Survey



Some of our Research projects

- Supporting VT Bee Breeders (2022- current)
- UBeeO hygienic behavior
- VT Pesticide Monitoring Project (2021-current)

Outline

- Pollinator Trends
- Threats
- Intro to Neonicotinoids
- Bee Lab VT Pesticide Monitoring
- Neonic Exposure Routes
- Crop Yields and Supporting Farmers


Inside the Hive

$235-577 Billion


Inside the Hive

VT's Honey Bee Industry

~17,000 registered hives in 2023

Of which, about half are migratory

Migratory colonies are propagated in south and trucked in for summer, temporarily doubling the VT hives for a short period of time

Beekeepers split hives in spring/summer to make up for losses. High losses impact beekeeper's profits

Colony Loss: Measurement of Bee Health

28.7%*

2021 VAAFM Winter Colony Loss

*Not included: Migratory operations and operations < 20 colonies

71.3%

2021 Bee Informed Partnership Annual Colony Loss

Since 2010, Vermont lost 15-85% colonies each year

Annual Losses

2016- 48.49%

2017- 57.1%

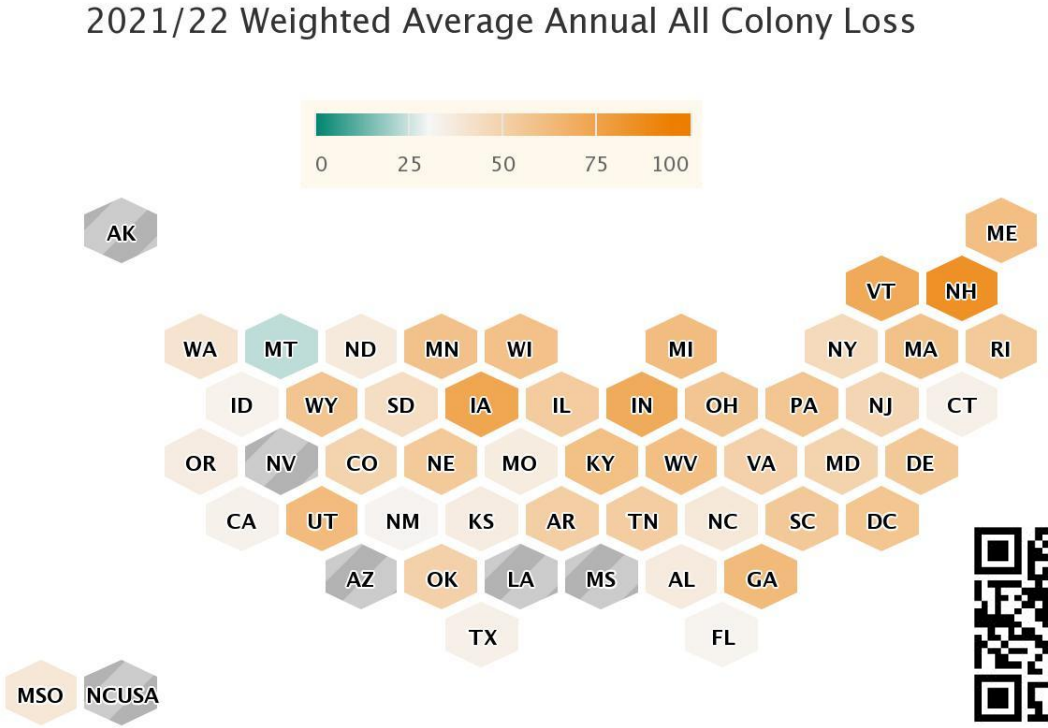
2018- 29.02%

2019- 38.34%

2020- 85.35%

2021- 71.29%

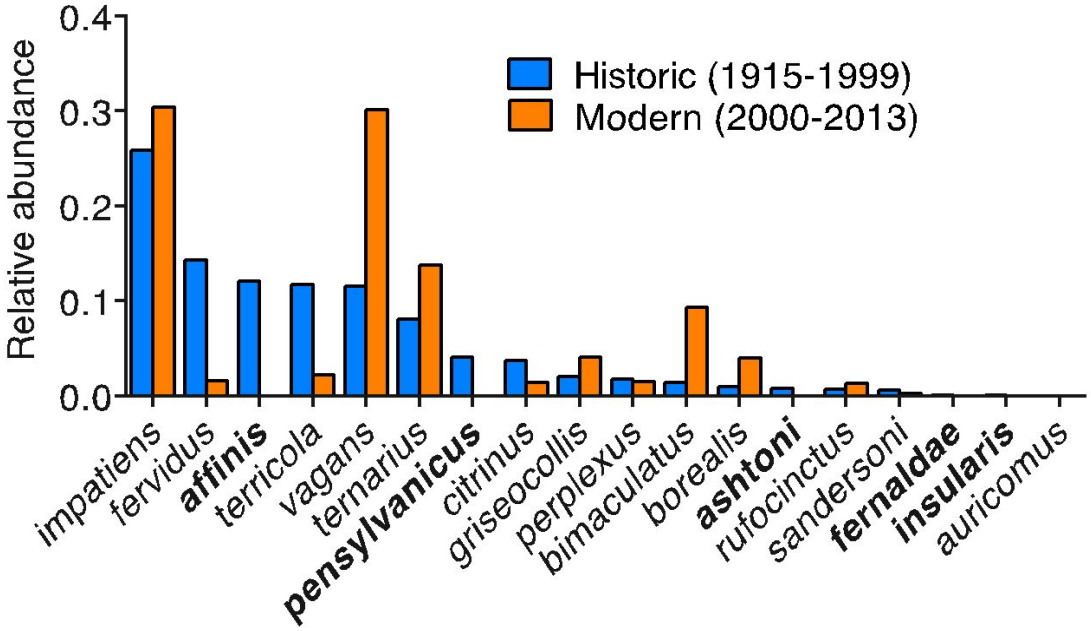
2022- 42.36%



Bee informed


© Sam Droege

Loss of 28% historical diversity



Richardson et al., 2018


State of Vermont's Wild Bees
State of Bees 2022
CURRENT KNOWLEDGE
THREATS
CONSERVATION
NEXT STEPS
Pruinose Squash Bee (*Peponapis Pruinosa*). © Spencer Hardy
VERMONT CENTER FOR ECOSTUDIES
Uniting People and Science for Conservation
VERMONT FISH & WILDLIFE

Vermont Center for Ecostudies Wild Bee Report

2019-2022

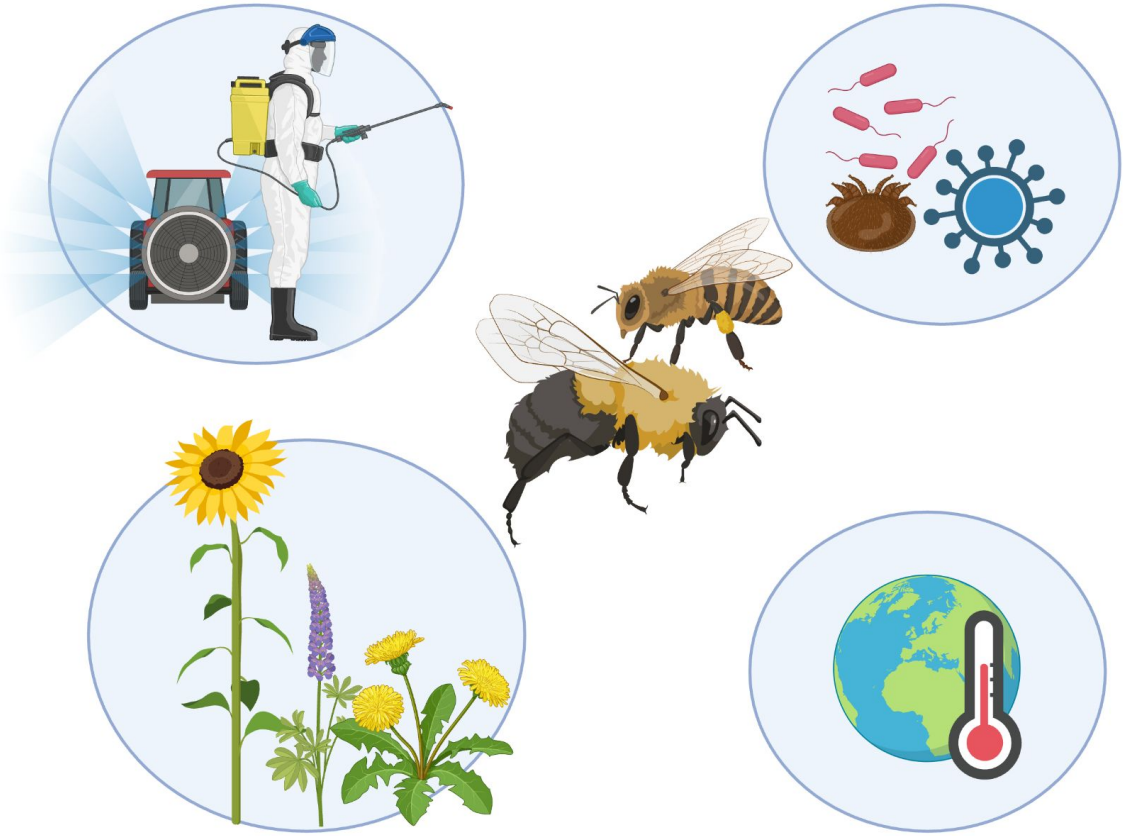
1,500+ observers in 250 towns

Observed 330 species

Over 30% of VT's native bee species ranked as critically imperiled or imperiled

55 of VT's 350 species are in urgent need of conservation action

https://conservation.stateofbees.vtatlasoflife.org/



Climate Change and Pollinators

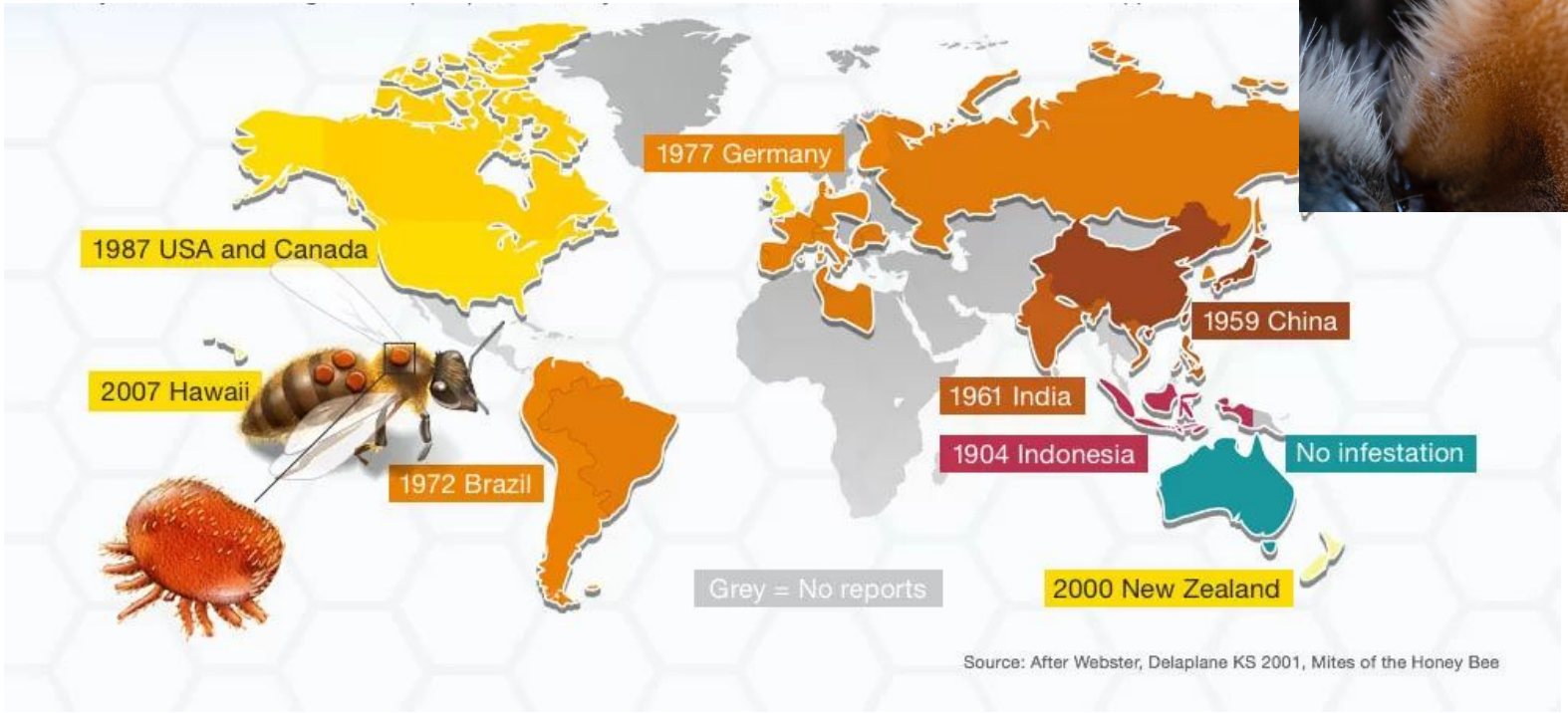
Droughts reduce forage

Fires and floods destroy bee habitat

Rising temperatures reduce habitat for some species (bumble bees lost 200 miles of habitat over the past 100 years)

Disruption of seasonal connections between plants and pollinators

Pests and Pathogens



Habitat and Availability of (non-toxic) Forage

Agricultural Intensification

Diminishes pollination by 3 to 6 fold

Native bees can provide great pollination

Intensification increases reliance on honey bee for pollination

Kremen et al., 2002

Pesticide Exposure Routes

Direct

Residue Contact

Contaminated Nesting Materials

Contaminated Nesting Areas

Pesticide Risks to Pollinators: Red Flags

- High Toxicity
- Widespread Use and/or Pesticide Moves Off-Site Easily
- Persistence (Slow Degradation Rates)
- Exposure pathways for pollinators

xerces.org

NY Birds and Bees Protection Bill

Phase out of neonicotinoid pesticides

- Restrictions on treated seed for row crops
- Restrictions on non-ag uses (turfgrass and ornamentals)

DECEMBER 22, 2023 | Albany, NY

Governor Hochul Signs "Birds And Bees" Act, Nation-Leading Legislation to Protect New Yorkers and Wildlife From Harmful Pesticides

Neonicotinoid Insecticides

Class of systemic insecticide

Used as seed coatings in majority of row crops (corn, soy, wheat)

Other uses include foliar sprays, soil drenches, truck injections

Crops: fruit and vegetables (apples, grapes, berries, cabbage, squash, others)

Turfgrass and ornamentals

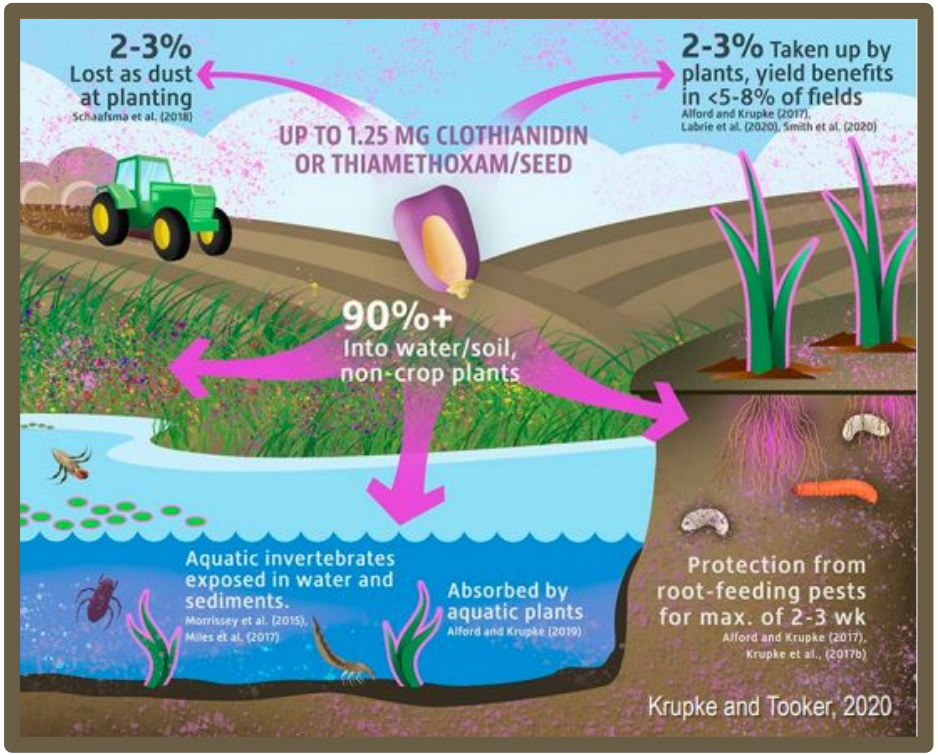
Properties of Neonicotinoids

Highly toxic to many classes of insects

Systemic, small molecules that are highly water soluble

Neonic treated seeds

- 2-3% taken up by plant
- >90% moves into soil, water, and non-crop plants
- Persistent in the environment for years



Impacts of neonicotinoids to pollinators

Impacts with very small concentrations

Neonics are “highly toxic” to pollinators

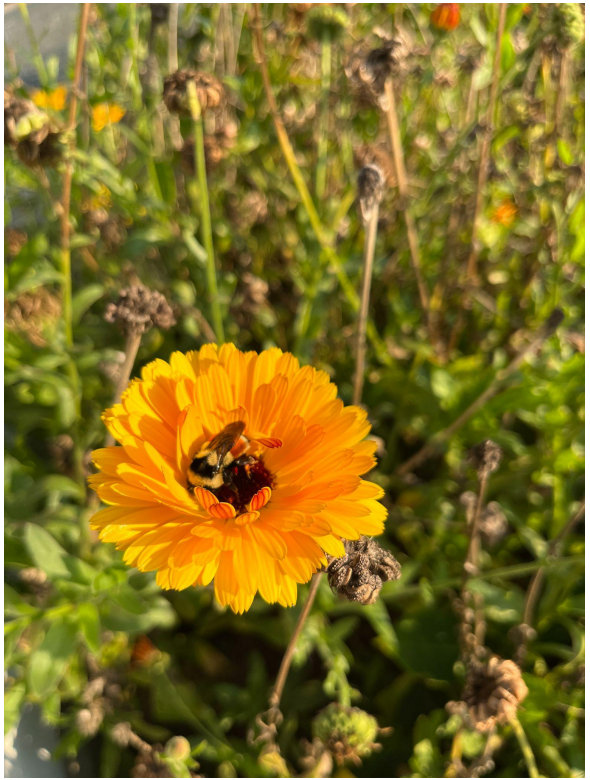
Sublethal exposures make bees less able to forage, grow larvae, and fight off disease

Impacts of Neonicotinoids to Pollinators

Reduction of wild bee density, solitary bee nesting, bumble bee growth and reproduction (Rundlöf et al., 2015)

Reduction of overwintering success, colony reproduction for both honeybees and wild bees (Woodcock et al., 2017)

Decreased survival and immune response in honey bees (Tsvetkov et al., 2017)



Are VT bees exposed to Neonics?

Vermont Pesticide Monitoring

Samples processed at Cornell Chemical Ecology Core Facility

$90/sample

Services available to beekeepers, farmers, government agencies, researchers

93-pesticide multi-residue screen

Limits of detection < 1 ppb for most pesticides

Vermont Pesticide Monitoring

In bee collected pollen samples:

- 2021 (16 samples): 81 detections of 20 pesticides

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Vermont Pesticide Monitoring

In bee collected pollen samples:

- 2021 (16 samples): 81 detections of 20 pesticides
- 2022 (18 samples): 89 detections of 23 pesticides

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SINCE 1886

Vermont Pesticide Monitoring

In bee collected pollen samples:

- 2021 (16 samples): 81 detections of 20 pesticides
- 2022 (18 samples): 89 detections of 23 pesticides
- **21% of pollen samples positive** for at least one of the ‘highly toxic’ neonics (clothianidin, imidacloprid, thiamethoxam). (n = 33)

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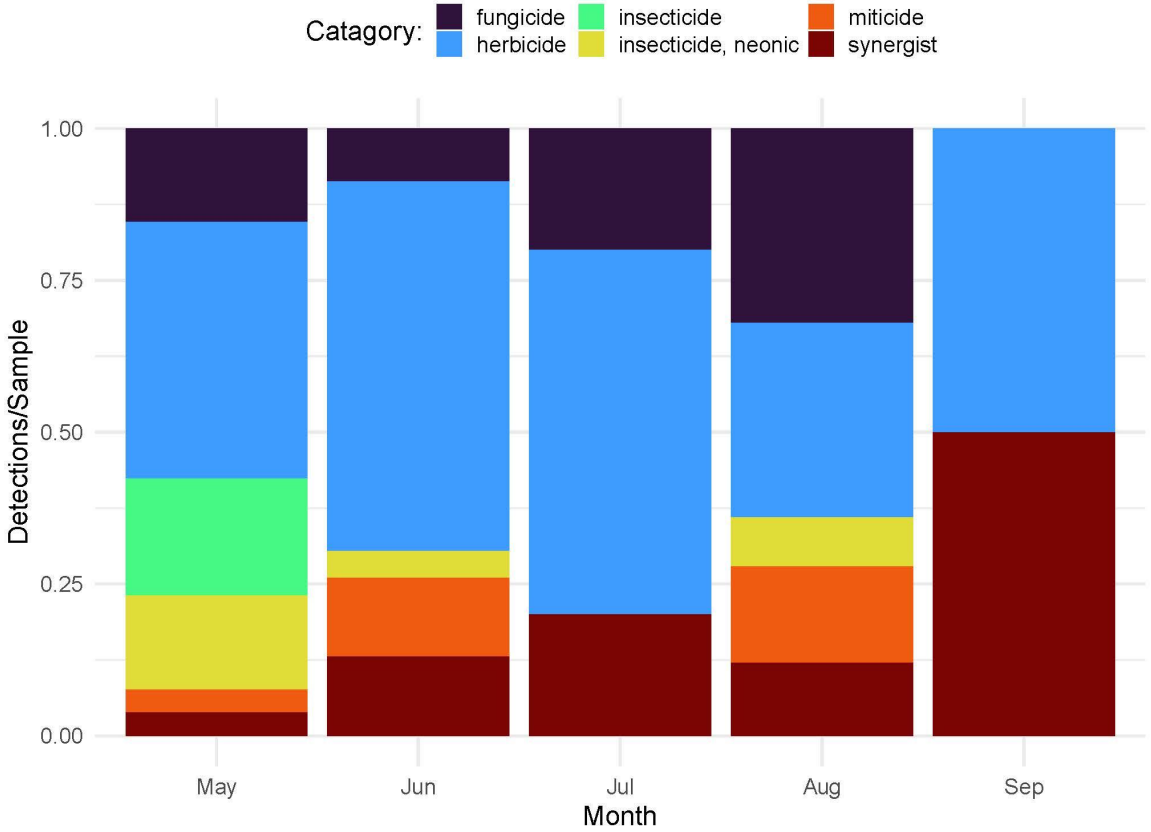
SINCE 1886

Vermont Pesticide Monitoring- 2021

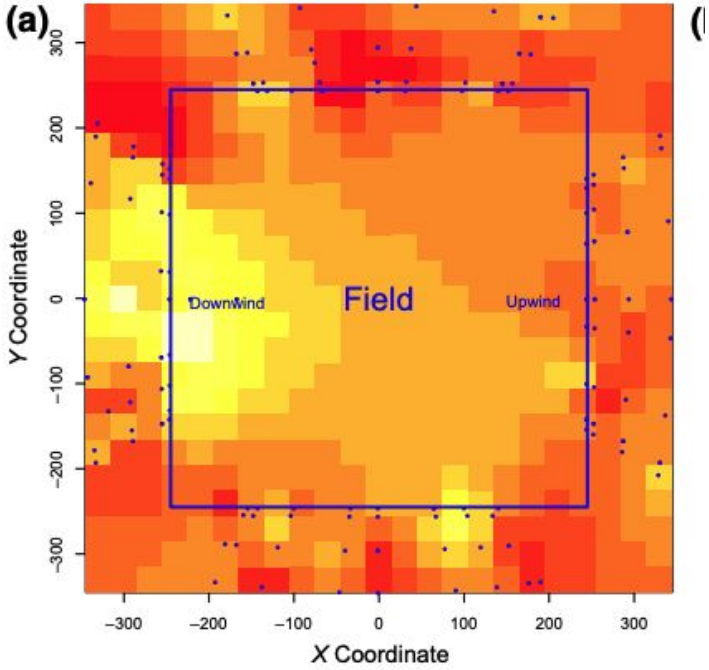


Neonicotinoid Exposure Routes

Dust during planting

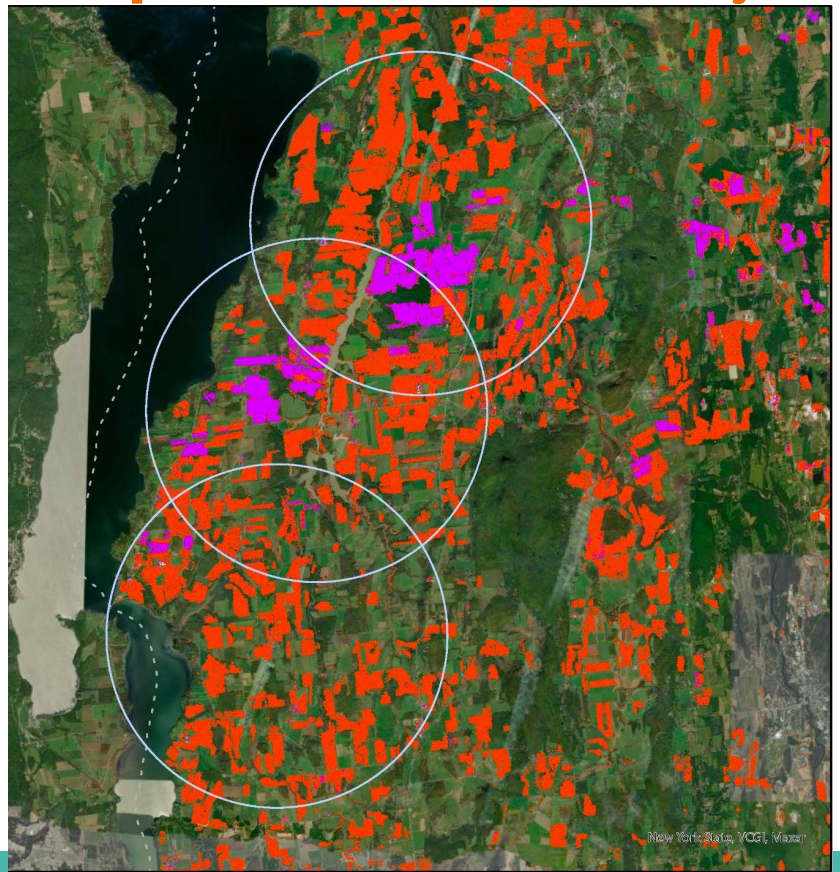
Concerns about dust started in 1999

Contaminated dust first implicated as potential route to bee exposure (Greatti et al., 2003)



Krupke et al., 2017

Corn and Soy Crops in Addison County



Vermont Pesticide Monitoring

2023:

- Focused sampling during and after planting
- 29 Apiaries with (17) and without (12) row crop
- 61 bee-collected pollen samples
- 22 flowering plant samples
- 6 soil samples

Vermont Pesticide Monitoring

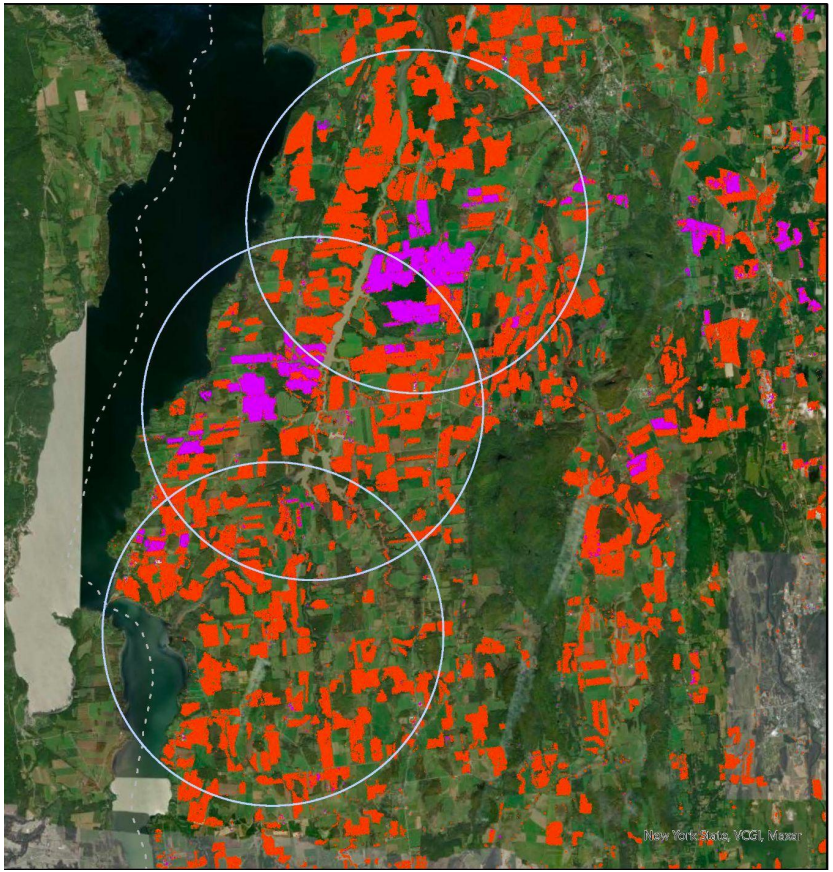
61 bee-collected pollen samples: 309 detections of 34 pesticides

Neonic Detections 

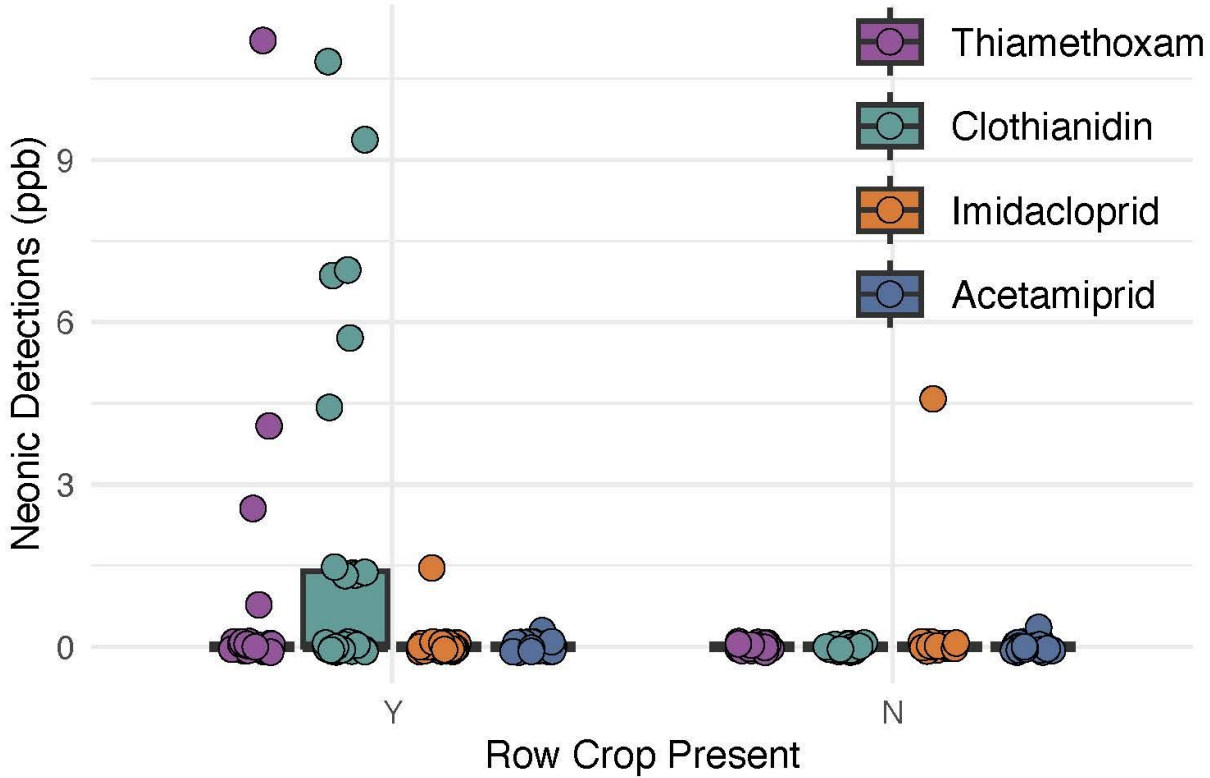
- 29.5% of all bee-collected pollen samples positive (18 of 61 samples)

Neonic Detections

- 29.5% of all bee-collected pollen samples positive (18 of 61 samples)
- 41% bee-collected samples from row crops (16 of 39 samples)



Neonic Exposure Linked to Row Crop Presence



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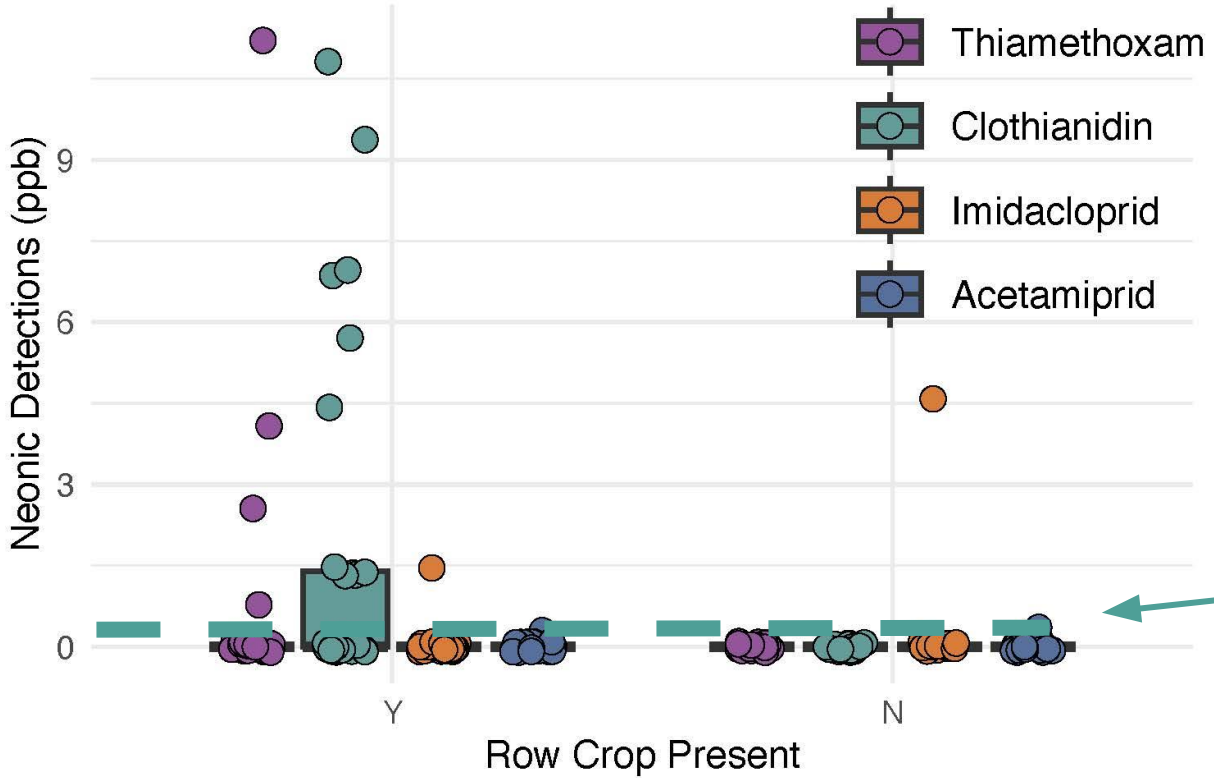
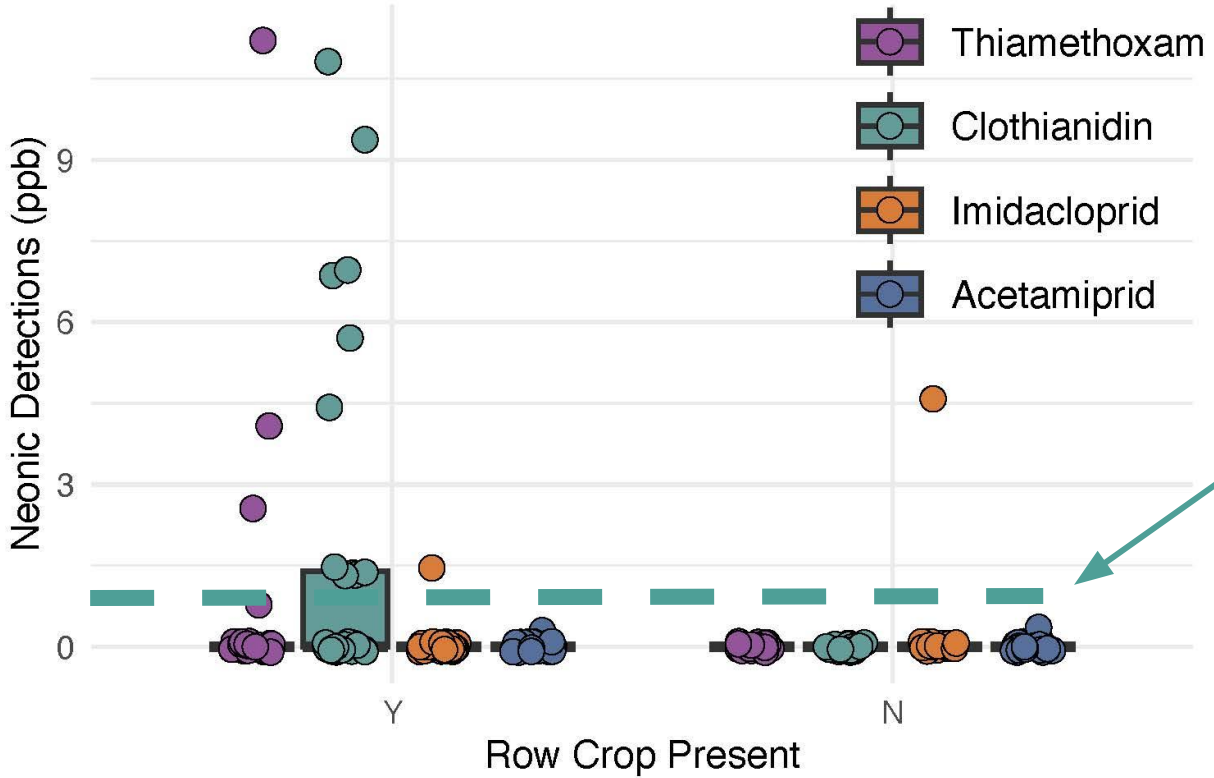


0.1 ppb: physiological impacts

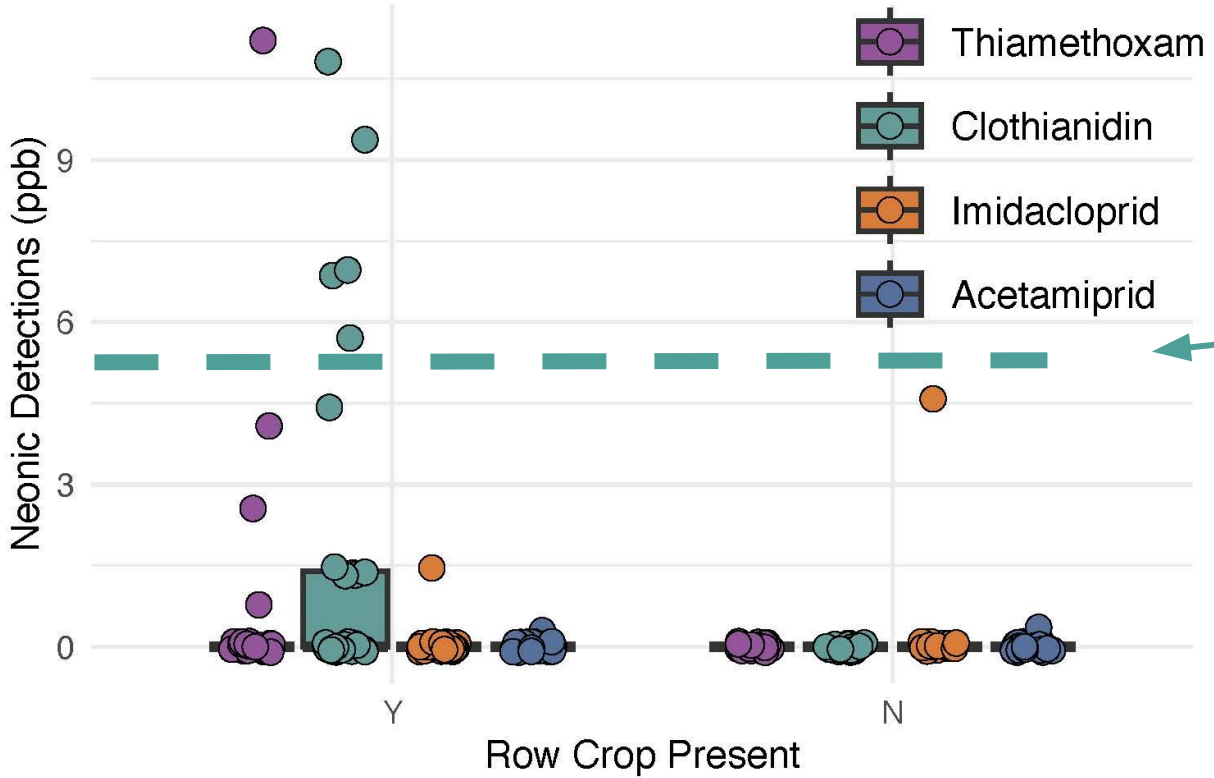
Neonic Exposure Linked to Row Crop Presence



0.9 ppb:

behavioral impacts, grooming behavior impacts, increased virus levels

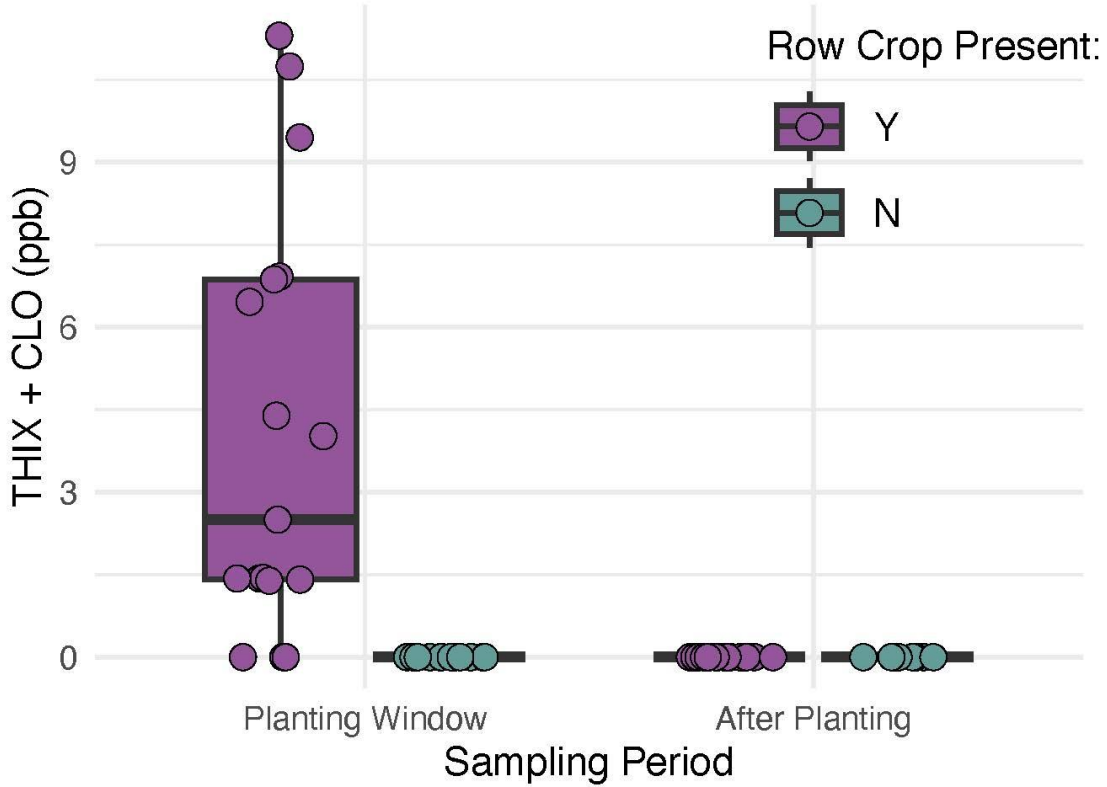
Neonic Exposure Linked to Row Crop Presence



5.12 ppb: Reproductive impacts

Queens 34% less likely to survive, fewer eggs

And During the Planting Window



Neonicotinoid Exposure Routes

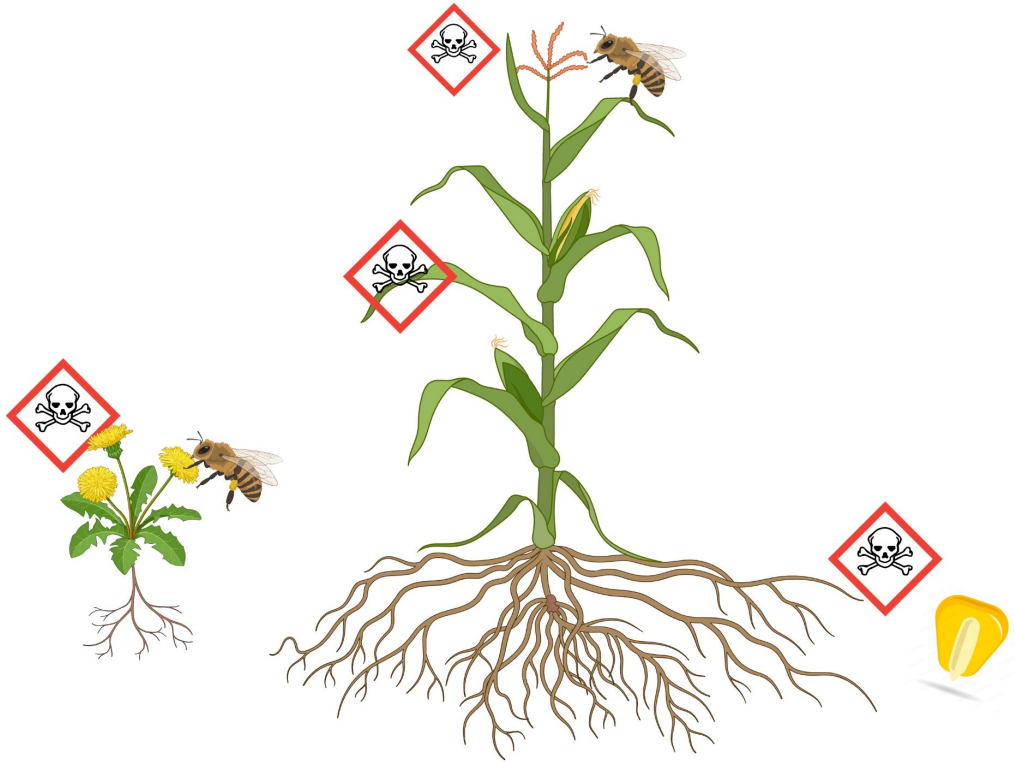
Pollen and nectar of treated plants

Clothianidin concentrations in corn pollen range from 1-6 ppb (Stewart et. al., 2014).

VT: Corn tassels range 1.79-7.53 ppb

Neonicotinoid Exposure Routes

Neighboring plants



Neonics on flowering plants

- 22.7% of flowering plant samples (5 of 22 samples)

Neonic Residues in Flowering Plants

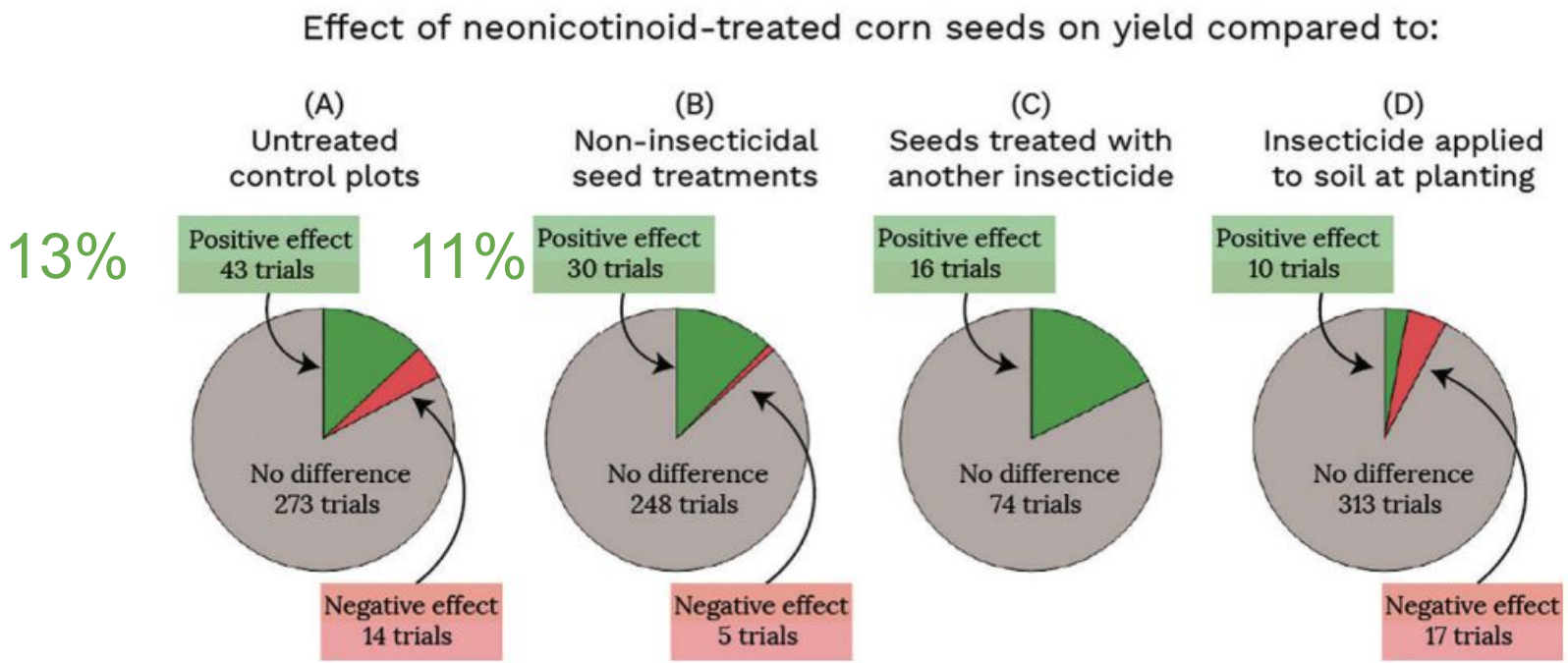
Dandelion: 1.02 - 8.23 ppb (CLO)

Apple tree: 7.88 ppb (CLO)

Goldenrod: 1.07 ppb (CLO)

Milkweed leaf: 10.3-13.6 ppb (THIX)

Neonics and Lack of Benefits for Crops

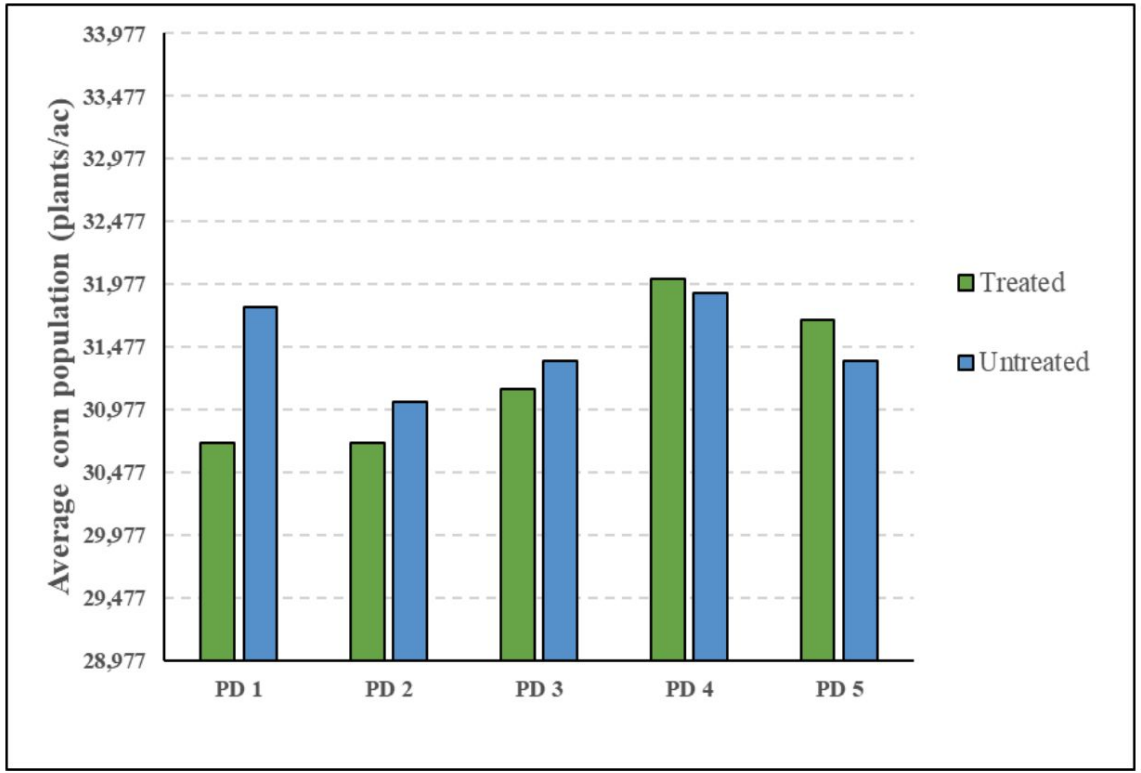


Change expected net income per acre:

- ***No difference*** compared to **untreated seeds**
- 1.4% to 3.7% benefit compared to **fungicide-treated seeds**
- ***No difference*** compared to **other seed treatments or soil-applied insecticides**

McArt, 2023 Ag innovation board presentation

Corn seedling damage assessment for neonicotinoid treated and untreated seed, Alburgh VT, 2023.

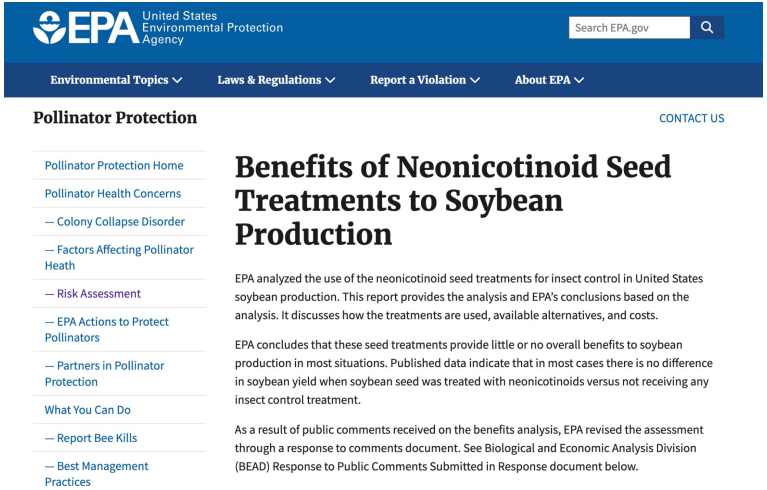


No significant differences seen across treated and untreated seeds within planting dates

Darby, 2023 Ag innovation board presentation

EPA Concluded Lack of Benefit for Soybean

“EPA concludes that these seed treatments provide little or no overall benefits to soybean production in most situations”



Quebec Farmer Panel Discussion

2024 Québec Farmer Panel on Transitioning Away From Neonic Treated Seeds

Attention Farmers!

Join University of Vermont Extension and the Vermont Bee Lab for a discussion with Québec farmers to learn about their experiences transitioning away from neonicotinoid ("neonic") treated seeds. In 2019, Québec limited neonic pesticide use to protect pollinators and our environment. Similar to the New York bill that was signed into law this past December, these restrictions applied to neonic coatings on corn and soybean seeds, two of the largest uses of neonics in the province.

In this panel discussion with four Québec farmers, we will learn how they navigated this transition and the challenges they faced. The panel includes the following farmers:

- Jocelyn Michon from La Présentation
- Renaud Peloquin from Sainte-Victoire-de-Sorel
- Stephane Pitre from Saint-Louis-de-Gonzague
- Francis Quintal from Saint-Ignace-de-Stanbridge

NORTHWEST CROPS & SOILS PROGRAM

THE UNIVERSITY OF VERMONT EXTENSION

THE UNIVERSITY OF VERMONT EXTENSION

Quebec's Experiences

Decrease in treated seed use:

- 2015: 99% corn and 50% of soybeans were treated
- 2023: 0.5% of corn, none in soybeans

No impacts to crop yields

Seed companies reacted and now supply non-insecticide treated seeds

Insurance companies reacted accordingly

Some farmers moved to diamide insecticides while others abandoned insecticide treatments all together

Quebec Farmer Panel Discussion, 2024

salger@uvm.edu

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