

# 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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# Outline

- Pollinator Trends
- Intro to Neonicotinoids and Bees
- Bee Lab VT Pesticide Monitoring
- Neonic Efficacy in Row Crops





**\$235-577 Billion (global)**









# 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 VAAF 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%

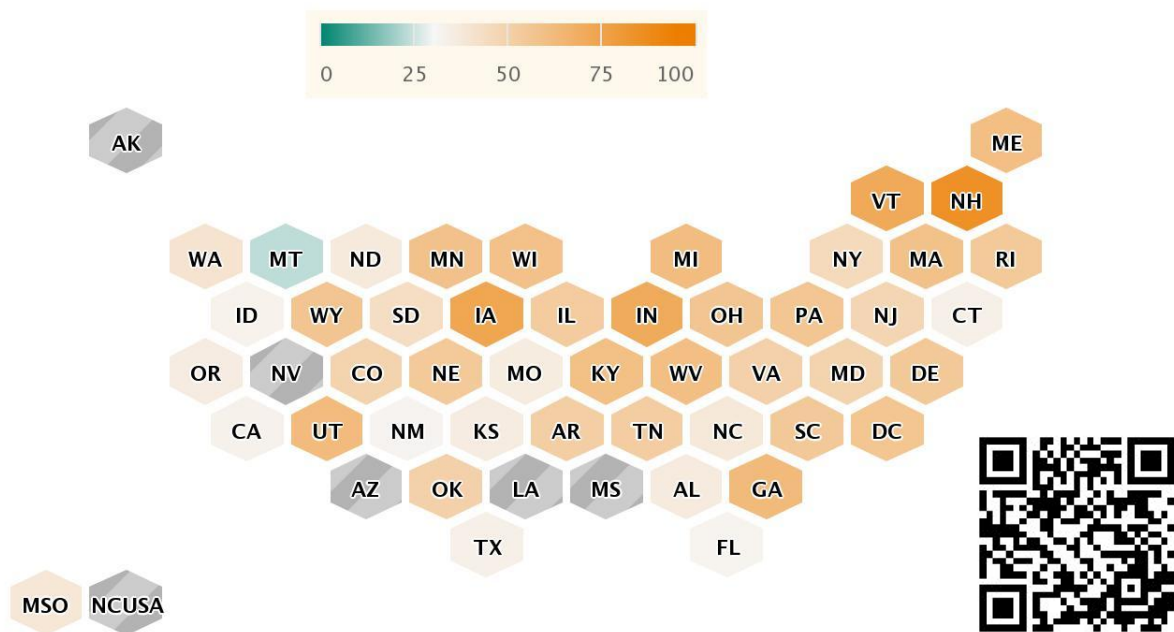
2019- 38.34%

2020- 85.35%

2021- 71.29%

2022- 42.36%

2021/22 Weighted Average Annual All Colony Loss



Bee informed





# 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 Center for Ecostudies Wild Bee Report



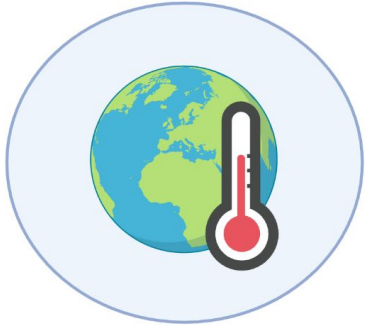
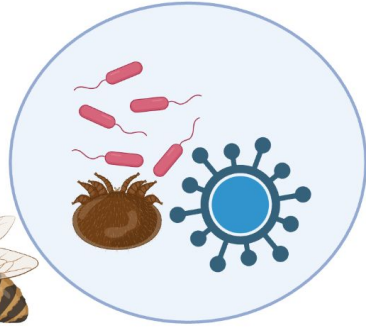
Over 30% of VT's native bee species ranked as critically imperiled or imperiled

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



© Spencer Hardy





# 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

Turfgrass and ornamentals



# Seed Treatment Insecticides in Corn and Soybeans

## Neonicotinoids

- Clothianidin
- Thiamethoxam
- Imidacloprid

All are highly toxic to bees

# Impacts of neonicotinoids to pollinators

Impacts with very small concentrations

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

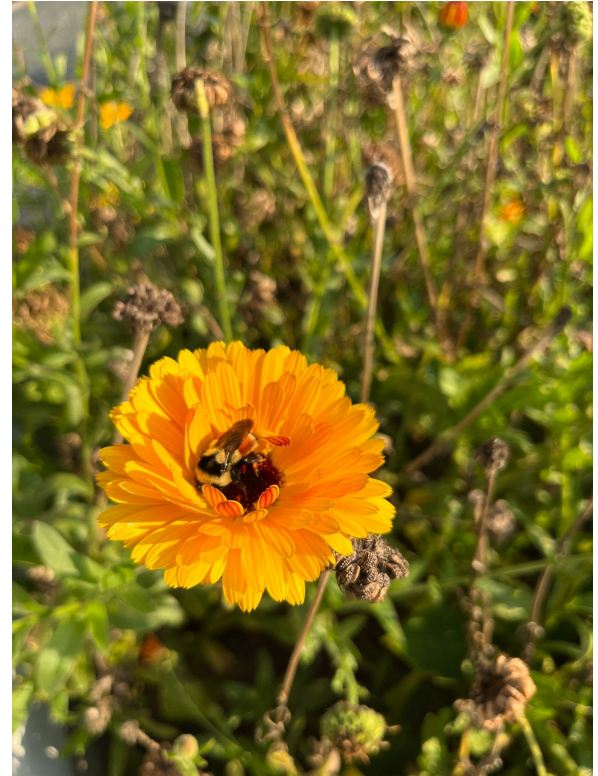


# Impacts of Neonicotinoids to Pollinators

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)



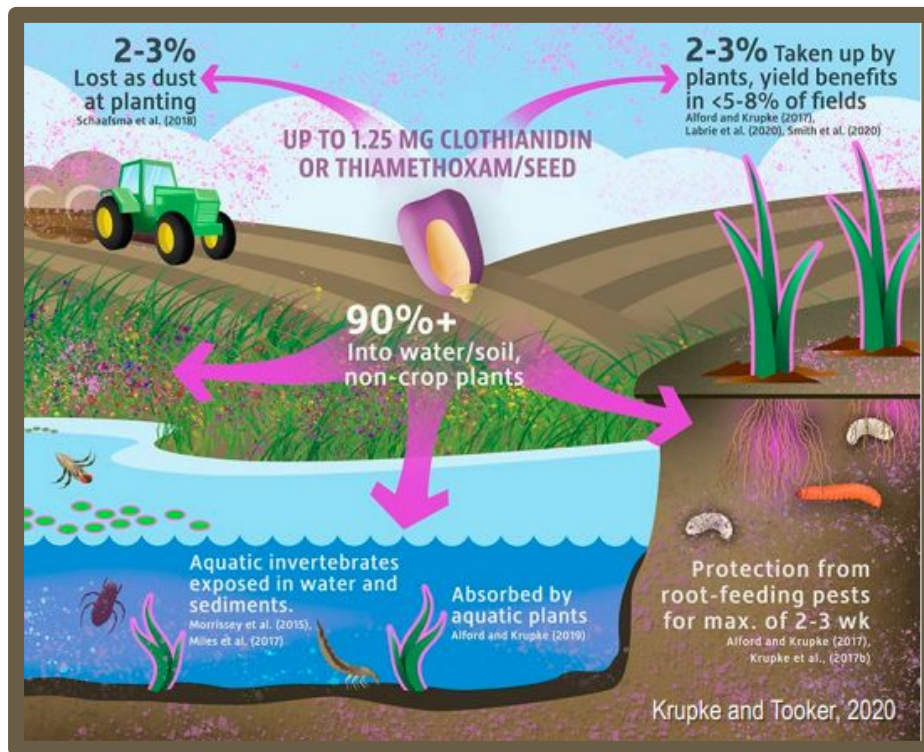
# Properties of Neonicotinoids

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



**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



# Vermont Pesticide Monitoring



In bee collected pollen samples:

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



# Vermont Pesticide Monitoring

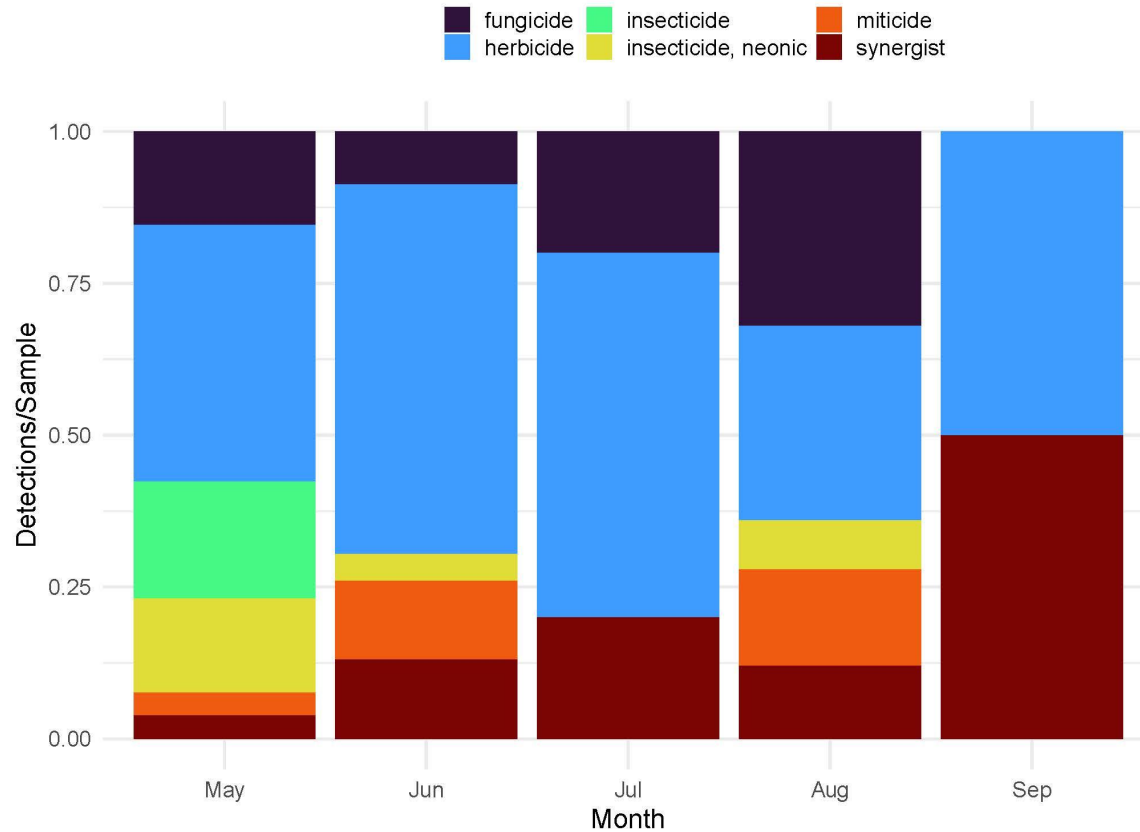


In bee collected pollen samples:

- 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)



# Vermont Pesticide Monitoring- 2021

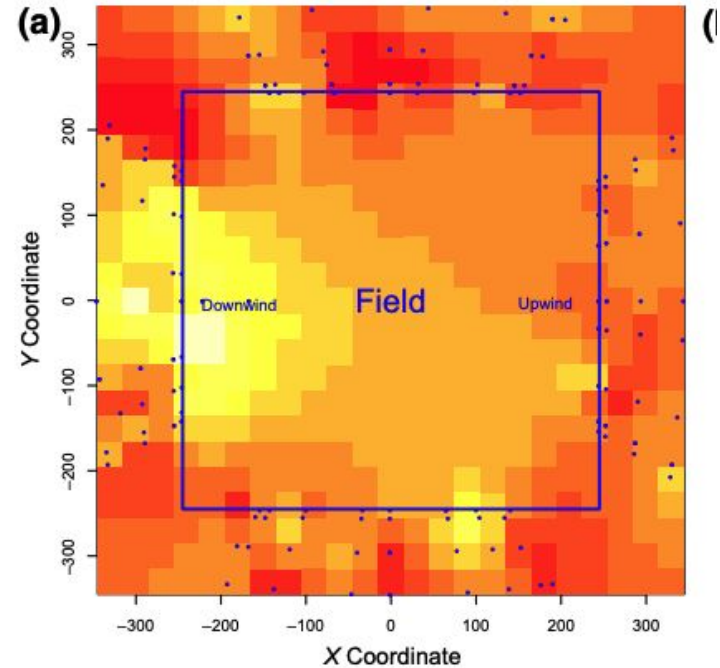


# Neonicotinoid Exposure Routes

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

# 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

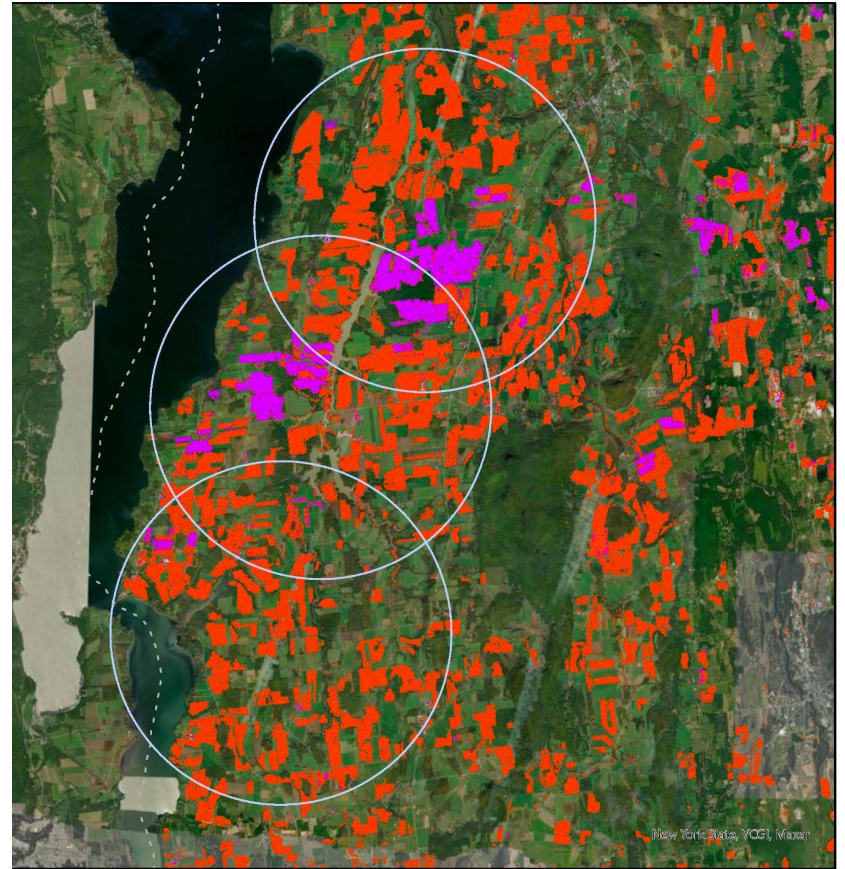


- 29.5% of all bee-collected pollen samples positive (18 of 61 samples)

# 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)



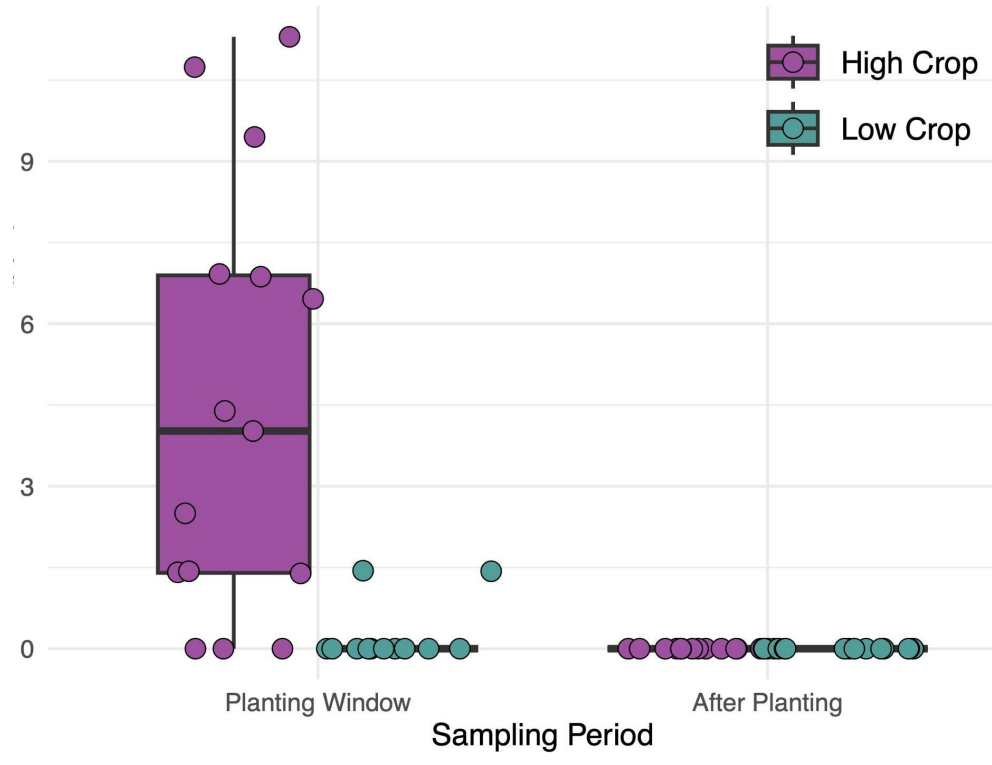








# And During the Planting Window





# Neonicotinoid Exposure Routes

Pollen and nectar of treated plants

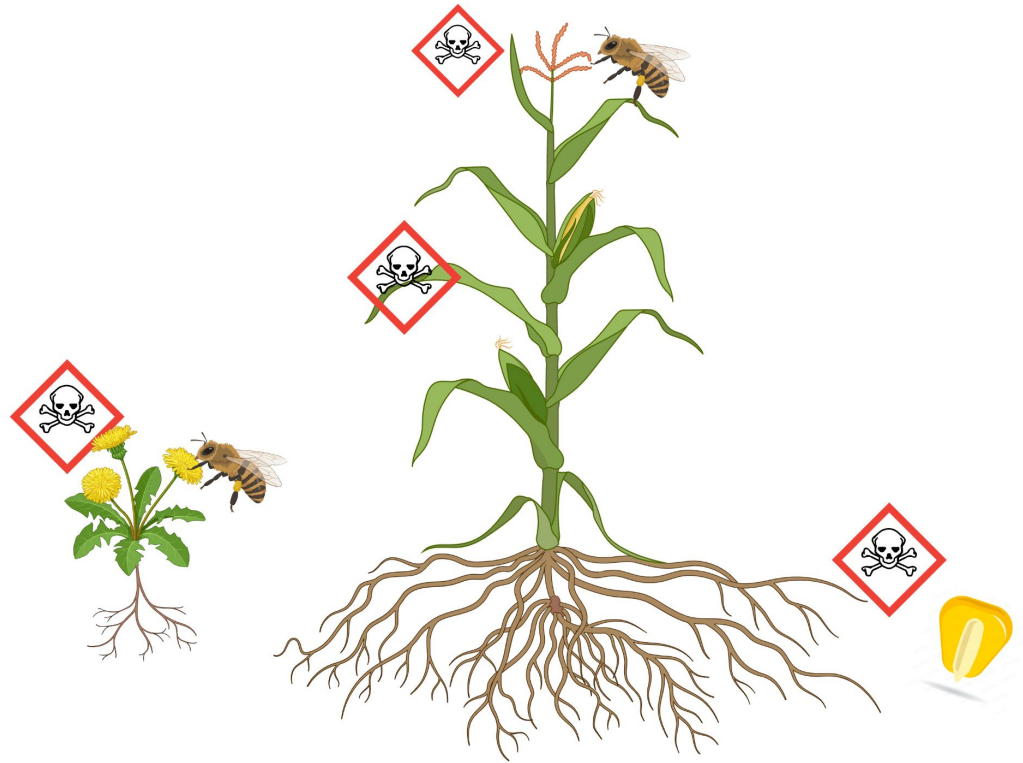
Clothianidin concentrations in corn pollen range from 1-6 ppb (Stewart et. al., 2014).

 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)

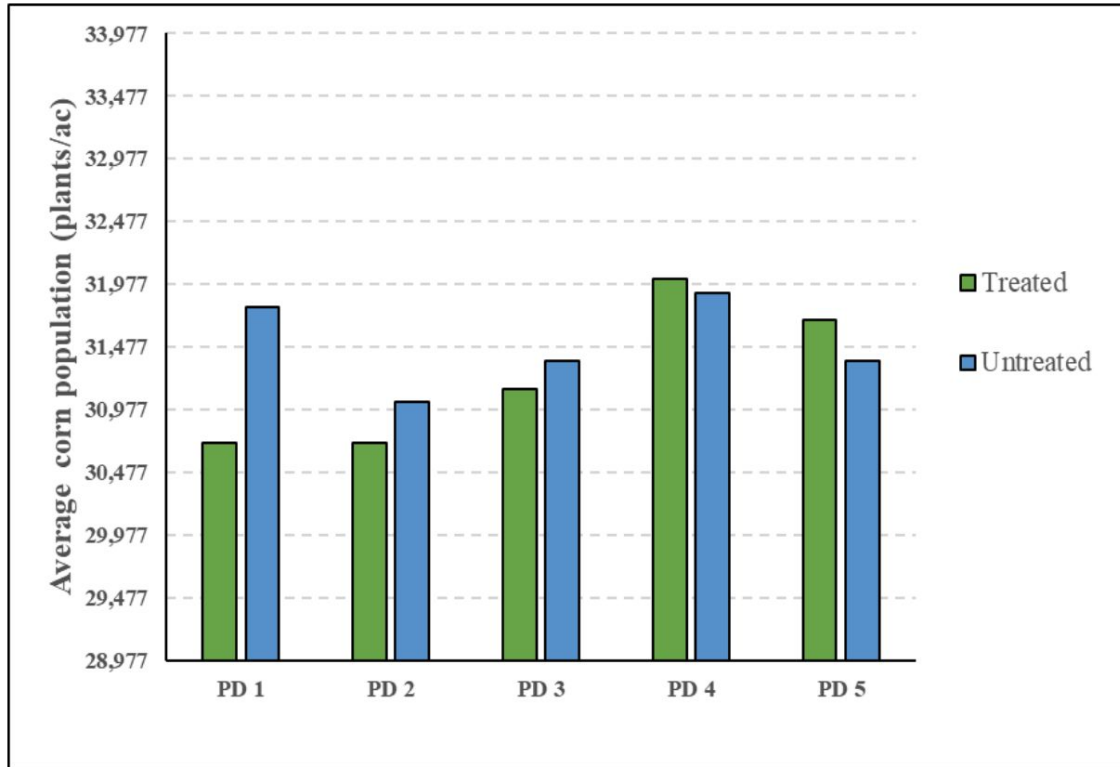
Goldenrod: 1.07 ppb (CLO)

Milkweed leaf: 10.3-13.6 ppb (THIX)



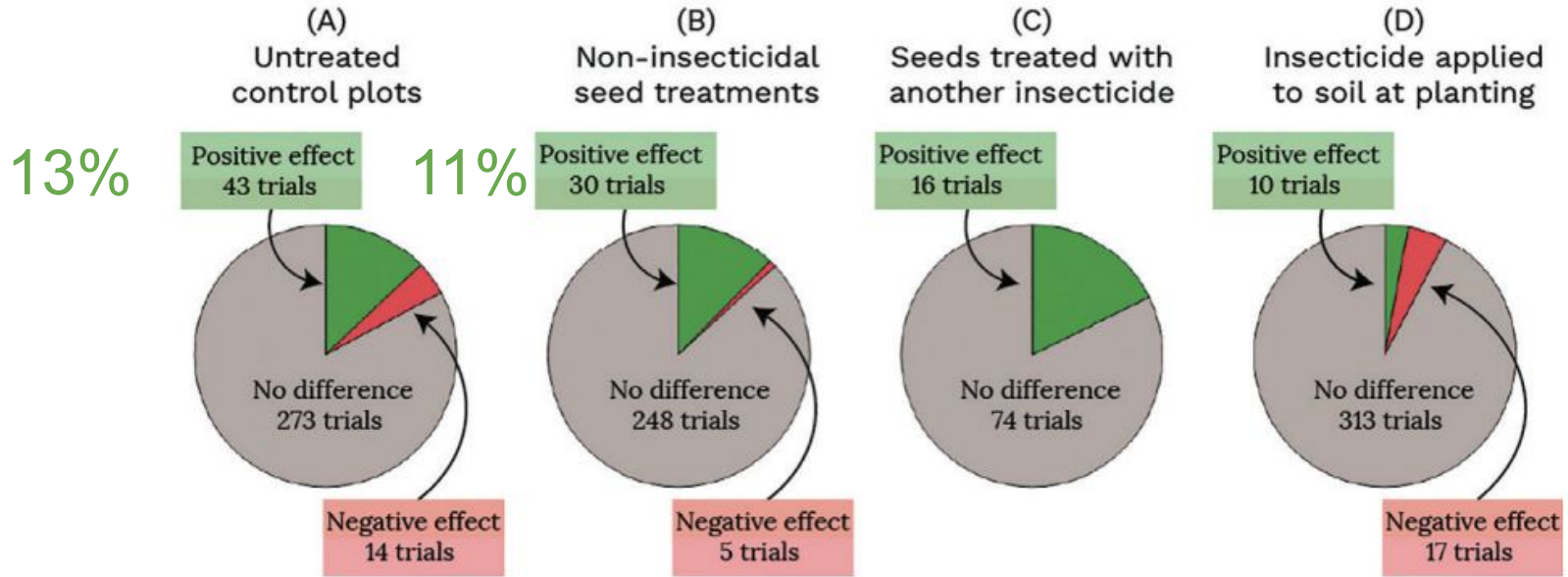
# Neonics and Lack of Benefits for Crops

# 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

## Effect of neonicotinoid-treated corn seeds on yield compared to:



Change expected net income per acre:

- **No difference** compared to **untreated seeds**

# 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”

The screenshot shows the EPA website interface. At the top is the EPA logo and navigation menu. The main content area features a sidebar with a list of links under 'Pollinator Protection' and a main article titled 'Benefits of Neonicotinoid Seed Treatments to Soybean Production'. The article text states that EPA analyzed the use of neonicotinoid seed treatments for insect control in United States soybean production and concluded that they provide little or no overall benefits in most situations.

**EPA** United States Environmental Protection Agency

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**Pollinator Protection** CONTACT US

- Pollinator Protection Home
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  - Factors Affecting Pollinator Health
  - Risk Assessment
  - EPA Actions to Protect Pollinators
  - Partners in Pollinator Protection
- What You Can Do
  - Report Bee Kills
  - Best Management Practices

## Benefits of Neonicotinoid Seed Treatments to Soybean Production

EPA analyzed the use of the neonicotinoid seed treatments for insect control in United States soybean production. This report provides the analysis and EPA's conclusions based on the analysis. It discusses how the treatments are used, available alternatives, and costs.

EPA concludes that these seed treatments provide little or no overall benefits to soybean production in most situations. Published data indicate that in most cases there is no difference in soybean yield when soybean seed was treated with neonicotinoids versus not receiving any insect control treatment.

As a result of public comments received on the benefits analysis, EPA revised the assessment through a response to comments document. See Biological and Economic Analysis Division (BEAD) Response to Public Comments Submitted in Response document below.



# NY Birds and Bees Protection Bill

NY is phasing 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**

# Quebec Farmer Panel Discussion



## 2024 Québec Farmer Panel on Transitioning Away From Neonic Treated Seeds

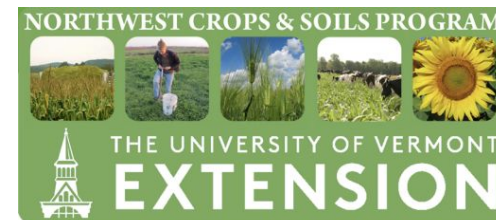
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### Attention Farmers!

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



# 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

# Persistence in soil

DT50 (half-life) in soils:

Clothianidin: 148 days - 6931 days (19 years)

Imidacloprid: 100 days- 1250 days (3.5 years)

Thiamethoxam: 7-335 days

Degradation higher at soil surfaces due to UV degradation

