

Documented losses of Vermont's wild and managed bees and causes:

- Beekeepers in Vermont have experienced overwintering losses of 30-60% over the last decade.
- In 2020-2021, Vermont beekeepers reported the second highest annual colony losses across all states. (Bee Informed Partnership, 2020).
- Several bumble bee species are in decline (Richardson et al., 2018).
- In March 2015, Vermont Fish and Wildlife listed 2 bumble bee species as state endangered and 1 species as threatened.
- Known threats to bees include: pesticide exposure, nutrition, pests and pathogens. These threats have synergistic effects on bees.

How are bees exposed to neonicotinoids?

- Exposure may be by contact (dust, soil), by ingestion (pollen, nectar, guttation water, exuded water droplets)
- Water droplets of leaves from seed-treated corn can reach concentrations of up to 100 ppm for thiamethoxam and clothianidin, and up to 200 ppm for imidacloprid (5-6 orders of magnitude higher than levels found in pollen and nectar). Dead bees were found after minutes of consuming these drops (Girolami et al., 2009).
- Untreated plants may absorb residues from the soil (Botías et al., 2015).
- Neonicotinoid residues move well beyond corn fields during sowing through dust and are deposited on non-target lands and waterways and are found at levels lethal to honey bees. Authors documented no benefit of insecticidal seed treatments for crop yield during the study (Krupke et al., 2017).

What are the effects of neonicotinoids on bees?

- Research has established the negative impacts of neonicotinoids on bees (see attached literature cited pages).
- This is supported by lab and field studies across honey bees, bumble bees, and solitary bee species. This includes treated seeds.
- Negative impacts of neonics associated with:
 - foraging and memory
 - pollination and efficiency
 - mortality and survival
 - reproduction and colony growth
 - immune system
 - interactions with pathogens
 - sociality and social interaction

National Honey Bee Survey Pesticide Testing

Background & Methods:

- Since 2016, UVM has conducted surveying as part of the USDA-APHIS National Honey Bee Survey.
- Survey examines bee pathogens as well as pesticide residues in bee hives.
- Each year, composite samples of either bee bread or wax are collected from ten apiaries. Each sample is a composite of 8 hives.
- Sample is tested for 193 different pesticides (insecticides, fungicides, and herbicides)

Results:

- From 2016-2020, 50 composite samples were analyzed.
- Since 2016, NHBS has detected neonicotinoids in 4% (2) of all samples (N=50)
- See attached table for full results

Caveats:

- NHBS sampling methods are meant to be employed at a national level.
- Sampling techniques underestimate exposure
- Bee bread and wax is pulled from very few cells (~4 cells/colony for bee bread)
- Mode of exposure: bees may be exposed through pollen, nectar, water droplets, contact
- The limit of detection for the neonicotinoids are as follows:
 - Acetamiprid 8ppb
 - Clothianidin 8 ppb
 - Dinotefuran 25 ppb
 - Imidacloprid 5 ppb
 - Thiacloprid 3 ppb
 - Thiamethoxam 10 ppb

National Honey Bee Survey Pesticide Results

Vermont 2016-2020

	Maximum (ppb)	Number of Detections
Varroacides		
Coumaphos	2480	38
Coumaphos oxon	281	27
2,4-Dimethylphenyl formamide (DMPF)	2980	22
Thymol	15200	22
Fluvalinate	612	20
Propargite	35	14
Fenpyroximate	11	10
Herbicides		
Metolachlor	Trace	21
Atrazine	6	14
Diuron	35	7
Acetochlor	Trace	5
Chlorothal dimethyl (DCPA)	Trace	4
Fluometuron	6	2
Trifluralin	Trace	2
Fungicides		
Carbendazim (MBC)	95	13
Hexythiazox	3	10
Diphenylamine	3	8
Chlorothalonil	Trace	3
Cyprodinil	5	3
Fenamidone	Trace	3
Boscalid	Trace	2
Captan	144	2
Difenoconazole	Trace	2
Penthiopyrad	12	2
Pyraclostrobin	Trace	2
4-OH Chlorothalonil	Trace	1
Fluopyram	Trace	1
Fluxapyroxad	5	1
Iprodione	Trace	1
Metalaxyl	Trace	1
Prothioconazole	Trace	1
Trifloxystrobin	2	1
Insecticides		
Carbaryl	8	7
Piperonyl Butoxide	26	7
DEET	Trace	5
Pirimiphos methyl	Trace	3
Tebufenozide	2	3
Acetamiprid	Trace	2
Chlorantraniliprole	14	2
Chlorpyrifos	Trace	2
Indoxacarb	5	2
DDE	Trace	1
Novaluron	Trace	1
Permethrin	Trace	1

Literature Review

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