June 28, 2023

RE: Supplemental Written Testimony About Neonicotinoid-Treated Seeds

Dear Ms. Griffith and Members of the Agriculture Innovation Board:

My name is Lucas Rhoads, and on June 26, 2023, I testified before the Board on behalf of the Natural Resources Defense Council (NRDC) and our over 2,500 members in the state of Vermont. My comments highlighted the wealth of published, peer-reviewed literature showing that neonicotinoid-treated corn and soybean seeds do not provide economic benefits to farmers in the Northeast region, contrary to the unpublished, non-peer-reviewed data presented by Professor Elson Shields earlier in the meeting. I also briefly addressed the significant amount of misinformation presented by Professor Shields and representatives of Corteva Agriscience at the meeting. Finally, in response to comments by Professor Shields that disparaged a comprehensive literature review published by Cornell University researchers, I urged the board to invite Scott McArt or other authors of that report to speak to the Board.

I now write to share the attached question-and-answer sheet to supplement and substantiate my earlier comments. Please note that this sheet was initially developed to support the Birds and Bees Protection Act in New York, though parts have been adapted for Vermont.

NRDC thanks the Board for the significant time and attention they have devoted to this critically important issue. We urge you to follow the science, as well as the lead of Vermont's neighbors in New York, Quebec, and Ontario, and recommend significant restrictions on neonic-treated seeds in Vermont. Please do not hesitate to contact me with additional questions about any of this information.

Sincerely,

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Setting the Record Straight: Frequently Asked Questions about Neonicotinoid-Treated Seeds

How Would Restrictions on Neonic-Treated Seeds Impact Growers?

Myth: *The loss of neonic-treated corn, soybean, and wheat seeds would lead to reduced production of key crops.*
Truth 1: **The findings of virtually every scientific study on the topic show this to be false**, including the Cornell report (review of 1,100+ peer-reviewed studies finding neonics provide "no overall net income benefit" to growers) and Labrie et al. (2020) (study of 84 fields across several regions of Quebec for 4 years finding "no yield difference was observed between neonicotinoid seed treatments and control plots in corn or soybean."), as well as the later-published Smith et al. (2020) (4-yr study of 160 corn and soybean fields in Ontario finding "that widespread use of seed-applied insecticides in corn and soybean is unlikely to provide benefit to producers") and Pacenka et al. (2021) (4-yr Purdue University study finding "the absence of a neonicotinoid [corn] seed treatment had no impact on yields.").

Truth 2: **Restrictions on neonic corn, soybean, and wheat seed treatments elsewhere have not impacted food production.** The lack of benefit of neonic-treated seeds has clearly been demonstrated in the European Union, where the use of neonic-treated corn and soybean seeds have been prohibited since 2013, yet crop production is either the same or increased (see here and here). Similarly neonic-treated seeds are being phased out in both Ontario and Quebec—e.g., by 2021 (see here [p. 7, in French, use Google Translate]), neonic treated corn seed use in Quebec had dropped from 100% to below .5%—and production levels have remained consistent.

Truth 3: **Neonic-treated seeds themselves threaten food security.** As backed up by the Cornell Report, neonic treated seeds are a leading cause of pollinator losses, and recent research reveals crops like apples and cherries are "pollinator limited" across the nation—meaning a lack of pollinators is already hampering production. A new study also finds that worldwide, pollinator declines have reduced fruit, vegetable, and nut production by 3-5%, reducing the availability of these healthy foods. Neonics are a leading and unequivocal driver of these losses (see, e.g., the Cornell Report, Pisa et al. (2021), Wood & Goulson (2017), Janousek et al. (2023)). Neonics also harm beneficial insects like nematodes, earthworms, and pest predators, and can harm microbial life critical to soil health (see also the written testimony of Prof. Tooker, Penn State).[1]

Myth: *Non-neonic-treated corn, soybean, and wheat seeds would be unavailable for farmers.*
Truth: **Non-neonic-treated conventional soybean and wheat seeds are already widely available**. (see 2021 hearing testimony at 3:13:30). Moreover, we have already seen markets adjust to new restrictions in other nations. The European Union banned the use of neonic-treated corn and soybean seeds in 2013, with Ontario and Quebec also significantly limiting their use.[2] Non-neonic treated seed was and is available and yields have been consistent. For example, **in Quebec, nearly 100% of corn seed was pre-treated with a neonic in 2015; in 2021, that number was less than .5%.**[3]

Myth: *Cornell research shows neonic seed treatments are necessary to combat seed corn maggot (SCM).*
Truth 1: **The findings of virtually every literature review and peer-reviewed study on the topic show neonic seed treatments are not necessary**, including the Cornell report (review of 1,100+ peer-reviewed studies), the later-published Smith et al. (2020) (4-yr study of 160 corn and soybean fields in Ontario finding "that widespread use of seed-applied insecticides in corn and soybean is unlikely to provide benefit to producers."), and Pacenka et al. (2021) (4-yr Purdue University study finding "the absence of a neonicotinoid [corn] seed

treatment had no impact on yields."). While an unpublished and non-peer-reviewed blog post from Cornell Prof. Shields finds pesticide seed treatments may benefit corn yields against SCM damage, the post remains an outlier, lacking critical information on the statistical methods, the underlying data, and field preparation.
Truth 2: **The conditions that lead to SCM damage are easily avoided.** Using a common corn/soybean crop rotation, employing early application of manure, using no-till practices, killing the cover crop before tilling (if tillage is used), reducing planting depth, delaying planting after tilling, or using "degree days" to calculate the correct planting time all significantly reduce SCM risk (see Sappington et al. (USDA 2018) and the Cornell Report). **Indeed, in 2007, professor Shields advised against neonic-seed treatments for corn in typical corn/soybean rotations** (see Cox, Cherney, Shields 2007 ["our study indicates that clothianidin seed treatment is not justified when corn follows soybeans"] and Cox, Shields, Cherney 2007 ["we do not recommend clothianidin seed treatment as inexpensive insurance against early-season soil insect damage when corn follows soybean"]).

Myth: Neonic seed treatments allowed a drop in seeding rates for soybeans, saving farmers money—if these treatments were eliminated, seeding rates would go back to 200,000 seeds per acre as they were in the 1990s to compensate from losses from seedcorn maggot, rather than the 140,000 per acre used today.
Truth: The main driver of the reduction in soybean seeds per acre since the 1990s is the dramatic increase in soybean seed prices, largely due to the rise of genetically engineered seed and monopolization of seed markets by a handful of large producers. **Research by virtually every major agricultural extension in the country, the Cornell Report, and EPA, finds that neonic treatments for soybean fail to provide net income benefits to farmers.** There is no data to support that seeding rates have increased elsewhere where neonic-treated seeds are no longer used, and there is no agronomic evidence to support that they would increase in Vermont.

Myth: Restrictions on neonic-treated seed would cause greater use of more harmful pesticides.

Truth 1: **Neonics have made U.S. agriculture up to 48-times more harmful to insect life since their introduction** in the mid-1990s, and have also dramatically increased the amount of land treated with insecticides.[4] Before neonics, only 35% of conventional corn acres and 5% of soybean acres were treated with an insecticide at all, but today, those numbers are nearly 100% and >50%, respectively, just for neonic-treated seed use alone. And because seed treatments provide only a couple weeks of protection very early in the season, to the extent there is a need to spray later in the season, seed treatments do not eliminate it. This means that seed treatments are often *in addition* to later season insecticide applications, such as cyhalothrin-lambda or cyfluthrin, which remain as or more common today than before the introduction of seed treatments.[5]

Seed treatments are also inefficient—only 2-5% is taken up by the target crop, leaving the other 95+% to persist in soil for years, where it is carried by rain to contaminate new soil, plants, and water. Regardless of total weight or volume used, neonics have made U.S. insecticide use more ecologically toxic and widespread.

Truth 2: **This hasn't happened in other countries that have restricted neonics.** Europe's 2013 ban on treated corn and soybean seeds was expanded to all outdoor uses for the three major neonic chemicals in 2018.[6] Where data exists for insecticide use alone, it indicates total use has dropped for the relevant crops, even as yields remained constant.[7] In both Europe and Canada, where other synthetic insecticides have been substituted for neonics, they are often from the newer anthranilic diamide class—which current research shows are much less toxic to bees, other wildlife, and people (see, e.g., here).

Neonics' Harms to Bees

Myth: Varroa mites and other stressors are driving honey bees losses, not neonics.
Truth: **Neonics have made bees more susceptible to varroa mites.** Varroa mites have afflicted Vermont's honey bees since the early 1990s,[8] but the recent spike in honey bee colony losses dates to the mid-2000s—around the time neonic use expanded rapidly—when losses suddenly jumped from roughly 10-15% to 40-50% annually.[9] The two causes are connected. Even miniscule, nonlethal neonic doses weaken bees' survival systems (immune system, navigation system, etc.), and recent studies show that neonic exposure increases honey bee susceptibility to varroa mites (see here, here, and here).[10] Accordingly, a significant number of losses beekeepers now attribute to varroa, likely would not have happened in a world without neonics.
Truth 2: **This claim is part of a well-funded industry campaign to deflect attention away from science showing neonics' harms to bees and other species.** While that science (much of which is summarized in the Cornell Report) is now voluminous and unequivocal, industry talking points continue to follow the longstanding script to deflect all the blame to varroa mites alone.
Truth 3: **This is irrelevant for the health of Vermont's native pollinators, environment, and people**. Varroa mites afflict only honey bees, while neonics harm all bees, butterflies and other insect pollinators, birds, bats, deer, fish, and possibly people too (see, e.g., NRDC's *Bigger Than Bees* report, ~9pgs.).[11] Many liken neonics' wide-ranging effects to a "second Silent Spring."[12]

Myth: Honey bee colony numbers are stable or increasing [implying there is no problem].
Truth 1: **This is misleading**. Both USDA and the Bee Informed Parnership, a national collaboration of leading research labs and agricultural universities, report astronomical losses of bee colonies nationwide beginning in the mid-2000s, just as neonic-treated seed use skyrocketed. **Honey bee populations are only stable because colonies are bred and replaced at a rapid pace to keep up with losses, often at great expense to beekeepers.**
Truth 2: **This is irrelevant to Vermont's hundreds of species of native bees**, which are experiencing similar losses,[13] but are not similarly bred and replaced. Recent research finds wild bees are as or more important than honey bees for pollinating top crops like apples and cherries.[14] The study also finds these crops are "pollinator limited," meaning if more pollinators were present, yields would be higher. With 87.5% of all flowering plants dependent on bees and other pollinators to reproduce,[15] further losses of native bees like the now-endangered rusty patched bumble bee threaten the health and viability of Vermont's ecosystems.

Neonics' Threats to Human Health

Myth: Neonics are safe for people.
Truth 1: **Authoritative health reviews report the many causes for concern about neonics' risks to human health,** as summarized in a **January 23, 2023, letter from health experts** to New York Gov. Kathy Hochul and legislative leadership. Neonics target neurological receptors found in the human brain, and pregnant women and children are especially vulnerable to harm. While the specific nerve receptor subunit that neonics bind to is more prevalent in invertebrate nervous systems compared to vertebrates, [16] it heavily populates critical areas of the mammalian brain that are essential in early life growth and development.[17] During this period, the human brain is uniquely susceptible to neurological poisoning.[18] And neonics are more long-lasting and migratory in the environment than older pesticides, meaning people are exposed to low doses over long periods of time. On any given day, at least half the U.S. population is exposed to neonics[19]—often through contaminated water and food. Even more recently, a study of 171 pregnant women in New York and five other states found that 95% of study participants had neonics in their bodies.[20]

Regulation of Neonics by EPA and Other Jurisdictions

Myth: EPA stringently and effectively regulates neonic-treated seeds.
Truth: **EPA exempts pesticide-treated seeds from federal pesticide regulation**, even though their intended pesticidal effect is identical to other registered pesticides. This loophole has led to tragic contamination events like that seen in Mead, Nebraska. It is also why—despite the New York Department of Environmental Conservation's refusal to register outdoor use of the neonic chemical due to water contamination and concerns—clothianidin is the most-used neonic in New York agriculture;[21] it enters the state as an unregulated seed treatment and planted across hundreds of thousands of acres statewide. The Cornell Report finds neonic-treated seeds posed "substantial" risks to bees and other pollinators. Yet, while both Europe and Canada have either banned or restricted neonic-treated seed use, the EPA, in the waning days of the Trump administration, proposed effectively continuing the status quo of its non-regulation of neonic-treated seeds.[22]

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[1] *See, e.g.,* Bradford et al., *Neonicotinoid-Containing Insecticide Disruption of Growth, Locomotion, and Fertility in Caenorhabditis Elegans*, PLOS ONE (Sep. 9, 2020), https://bit.ly/3F5t28U; Pisa et al., *Effects of Neonicotinoids and Fipronil on Non-Target Invertebrates,* Envtl. Sci. Pollution Res. Int. (2015), https://bit.ly/3n7QvjD; Frank & Tooker, *Opinion: Neonicotinoids Pose Undocumented Threats to Food Webs*, PNAS (Sep. 15, 2020), https://bit.ly/3t7AxK8; Parizadeh et al., *Neonicotinoid Seed Treatments Have Significant Non-target Effects on Phyllosphere and Soil Bacterial Communities* (Jan. 2021), https://bit.ly/3n2vsPI.

[2] Commission Implementing Regulation (EU) No 485/2013 of 24 May 2013, https://bit.ly/3uW1b7f; Credit Valley Conservation, Ontario Limits Pesticide Use to Help Pollinators (Aug. 1, 2017), https://bit.ly/2Pzfkah; CBC News, *Quebec Places New Restrictions on Pesticides in Bid to Protect Honeybees* (Feb. 19, 2018), https://bit.ly/3ebRTyb.

[3] Ministère de l'Environnement et de la Lutte Contre les Changements Climatiques, Quebec, *Bilan des ventes de pesticides au Québec: Année 2019*, 15 (2021) https://bit.ly/3zs9H0t.

[4] Michael DiBartolomeis et al., *An Assessment of Acute Insecticide Toxicity Loading (AITL) of Chemical Pesticides Used on Agricultural Land in the United States*, PLoS One (Aug. 6, 2019), https://bit.ly/2Yr4Xc7; Margaret Douglas et al., *County-level Analysis Reveals a Rapidly Shifting Landscape of Insecticide Hazard to Honey Bees (Apis Mellifera) on US Farmland*, Scientific Reports (Jan. 21, 2020), https://go.nature.com/2SKhjHP.

[5] U.S. Geological Survey (USGS), *Estimated Annual Agricultural Pesticide Use: Cyhalothrin-Lambda*, https://on.doi.gov/3LihT9M; USGS, *Estimated Annual Agricultural Pesticide Use: Cyfluthrin*, https://on.doi.gov/3Vgbm40.

[6] Declan Butler, *Scientists Hail European Ban on Bee-Harming Pesticides*, Nature (Apr. 27, 2018), https://go.nature.com/3ibsftg.

[7] Letter from Prof. Dave Goulson to New York State Governor Andrew Cuomo (Jan. 28, 2020), https://on.nrdc.org/3svzmBG.

[8] *See* Wenner & Bushing, *Varroa Mite Spread in the United States*, Bee Culture (1996), https://bit.ly/2v0rkb7.

[9] *See* Alex Morris, *What Is Killing America's Bees and What Does It Mean for Us?*, Rolling Stone (Aug. 18, 2015), https://bit.ly/3hkr2QG; Pierre Mineau, *Impacts of Neonics in New York Water*, p. 7 (2019), https://on.nrdc.org/2lXsO0O [hereinafter "Mineau 2019"].

[10] *See* Pisa, "Update of the Worldwide Assessment: Part 2"; Desiderato Annoscia et al., *Neonicotinoid Clothianidin Reduces Honey Bee Immune Response and Contributes to Varroa Mite Proliferation*, Nature Communications (Nov. 18, 2020), https://go.nature.com/3igncb3; Lars Straub et al., *Neonicotinoids and Ectoparasitic Mites Synergistically Impact Honeybees*, Scientific Reports (Jun. 4, 2019), https://go.nature.com/2WTIjU8 ("Our data clearly show a significant negative synergistic effect of neonicotinoids and *V. destructor* mites on *A. mellifera* honeybee body mass and longevity"); Nuria Morfin et al., *Effects of Sublethal Doses of Clothianidin and/or* V. Destructor *on Honey Bee (*Apis Mellifera*) Self-Grooming Behavior and Associated Gene Expression*, Scientific Reports (Mar. 2019), https://go.nature.com/2IXL5Tq (finding low levels of exposure to the neonic clothianidin reduced honey bee grooming behavior that helps bees rid themselves of the mites).

[11] *See, e.g.,* Margaret L. Eng et al., *A Neonicotinoid Insecticide Reduces Fueling and Delays Migration in Songbirds*, Science (Sep. 13, 2019), https://bit.ly/2kGS1MA; Caspar A. Hallmann et al., *Declines in Insectivorous Birds Are Associated with High Neonicotinoid Concentrations*, Nature (Jul. 17, 2014), https://go.nature.com/2NUV26w; Laurianne Geffroy, *Where Have all the Farmland Birds Gone?*, CNRS News (Mar. 21, 2018), https://bit.ly/2GcNCL4; Pierre Mineau & Carolyn Callaghan, *Neonicotinoid Insecticides and Bats*, Canadian Wildlife Federation (2018), https://bit.ly/2kSfs5K; Matthew L. Forister et al., *Increasing Neonicotinoid Use and the Declining Butterfly Fauna of Lowland California*, The Royal Society Publishing: Biology Letters (Aug. 1, 2016), https://bit.ly/2o5P6i0; Andre Gillburn et al., *Are Neonicotinoid Insecticides Driving Declines of Widespread Butterflies?*, PeerJ (Nov. 24, 2015), https://bit.ly/1lGvH0y; Elise Berheim et al., *Effects of Neonicotinoid Insecticides on Physiology and Reproductive Characteristics of Captive Female and Fawn White-tailed Deer*, Scientific Reports (Mar. 14, 2019), https://go.nature.com/3bEghEG; Jim Daley, *As Pesticide Turns Up in More Places, Safety Concerns Mount*, Scientific American (Apr. 30, 2019), https://bit.ly/2oft0dv; Masumi Yamamuro et al., *Neonicotinoids Disrupt Aquatic Food Webs and Decrease Fishery Yields*, Science (Nov. 1, 2019), https://bit.ly/34rKCSG.

[12] *See, e.g.,* Damian Carrington, *Fishery Collapse 'Confirms Silent Spring Pesticide Prophecy'*, The Guardian (Oct. 31, 2019), https://bit.ly/2LsiBXr; Jason Bittel, *Second Silent Spring? Bird Declines Linked to Popular Pesticides,* Nat. Geo. (Jul. 9, 2014), https://bit.ly/2HbC4bE.

[13] For example, neonic use is cited as a cause of the recent endangered species listing for the rusty patched bumble bee—a common bee in Vermont as recently as the 1990s, but that hasn't been seen in the state since the year 1999. U.S. Fish and Wildlife Service (USFWS), *Rusty Patched Bumble Bee Status Assessment*, 62 (Jun. 2016), http://bit.ly/2Wl7qnA; Vermont Center for Ecostudies, Rusty Patched Bumble Bee, https://val.vtecostudies.org/projects/bumble-bee-atlas/bombus-affinis/.

[14] J.R. Reilly et al., *Crop Production in the USA Is Frequently Limited by a Lack of Pollinators*, Proceedings of the Royal Society B (Jul. 29, 2020), https://bit.ly/3nMLQkN.

[15] Jeff Ollerton et al., *How Many Flowering Plants Are Pollinated by Animals?* Oikos (Feb. 21, 2011), https://bit.ly/3tM2w2e.

[16] Tomizawa M, Casida JE. *Neonicotinoid Insecticide Toxicology: Mechanisms of Selective Action*. Annu Rev Pharmacol Toxicol. 2005;45:247-68. doi: 10.1146/annurev.pharmtox.45.120403.095930. PMID: 15822177.

[17] Posadas I, López-Hernández B, Ceña V. *Nicotinic Receptors in Neurodegeneration*. Curr. Neuropharmacol. 2013 May;11(3):298-314. doi: 10.2174/1570159X11311030005. PMID: 24179465; PMCID: PMC3648781

[18] Haddad-Tóvolli R, Dragano NRV, Ramalho AFS, Velloso LA. Development and Function of the Blood-Brain Barrier in the Context of Metabolic Control. Front Neurosci. 2017 Apr 21;11:224. doi: 10.3389/fnins.2017.00224. PMID: 28484368; PMCID: PMC5399017.

[19] M. Ospina et al., Exposure to Neonicotinoid Insecticides in the U.S. General Population, Envtl. Res. (Jun. 24, 2019) https://bit.ly/2q11yRf.

[20] Jessie Buckley et al., Exposure to Contemporary and Emerging Chemicals in Commerce among Pregnant Women in the United States: The Environmental influences on Child Health Outcome (ECHO) Program, Environ. Sci. Technol. 56(10), 6560-6579 (2022), https://pubs.acs.org/doi/10.1021/acs.est.1c08942.

[21] Mineau 2019 at 9.

[22] *See* NRDC, *Comments on the Proposed Interim Registration Review Decisions for the Neonicotinoid Insecticide Class* (May 4, 2020), https://on.nrdc.org/35KomGE.