New bee-friendly restrictions on neonicotinoid insecticides in New York … and a barrier to further progress on this topic in the USA

In the two previous *Notes from the Lab* columns, I focused on the scientific evidence that pesticides are currently harming bees, and specific ways in which the current pesticide risk assessment process overseen by regulatory agencies such as the EPA is inadequate [see January and February 2024 columns: 164(1):57-60 and 164(2):197-200]. In other words, I showed that science has identified a problem with pesticides, then highlighted one way to fix the problem.

As everyone knows, fixing a problem before it starts is better than fixing a problem that's existed for several years. For example, improving the risk assessment process so bee-harming pesticides aren't sold is better than realizing after several years that environmental harm has been done, then creating reactionary laws to ban the pesticide. But either way of fixing a problem is better than ignoring it.

So, until the pesticide risk assessment process is improved, unfortunately we have to rely on reactionary laws that ban harmful pesticides. For the seventy-third *Notes from the Lab*, I'm going to highlight one of these reactionary laws. Specifically, I'm going to highlight recent nation-leading legislation in New York that will restrict certain uses of neonicotinoid insecticides due to the overwhelming scientific evidence, accumulated over more than two decades, that shows frequent risk to bees and infrequent economic benefits for farmers. This legislation is an attempt to fix a problem that's existed for half of my lifetime.

But I'm also going to temper this new evidence-based policy with a warning. I'm going to highlight two examples from the 3.5-year deliberation over this new law that reveal a major barrier to evidence-based pesticide policies in the USA: disinformation from a small number of scientists whose goal is to obscure scientific evidence, thereby delaying or preventing regulation.

Let's get into it. First, for anyone who's tired of reading about neonicotinoid insecticides (neonics), let's acknowledge that neonics aren't the only stress that's causing problems for bee species. In fact, they're not the only pesticide class that's causing problems for bees. Last month's article was especially useful at showing how exposure to indoxacarb (an oxadiazine insecticide) and six other non-neonicotinoid insecticides reduced reproduction of bumble bee colonies across 106 farms in Europe. But that doesn't mean exposure to neonics isn't a major stress on bees. As described below, there's extensive evidence that neonics are indeed having a negative impact on bees in the USA.

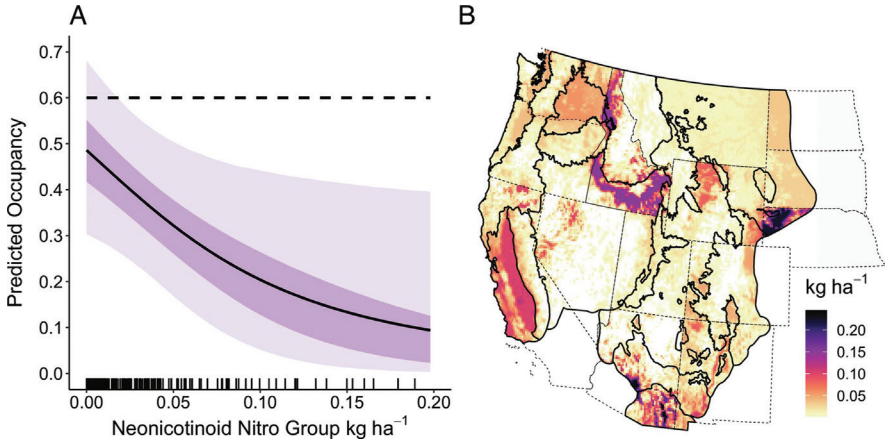

Fig. 1 *(A) Mean predicted occupancy for the western bumble bee (Bombus occidentalis) as a function of increasing neonicotinoid (nitroguanidine group) application rate (kg ha^{-1}), 2008 to 2014, in the conterminous United States (shaded ribbons indicate the 95% (light) and 50% (dark) credible interval regions). Dotted line represents mean predicted occupancy in the absence of any neonicotinoid use (0.60). Hash marks on x-axis indicate observations of varying neonicotinoid loads in observed data. (B) Map of mean maximum neonicotinoid application rate on croplands during 2008 to 2014 by ecoregion. Figure from Janousek et al., 2023.*

Figure from Krupke & Tooker, 2020

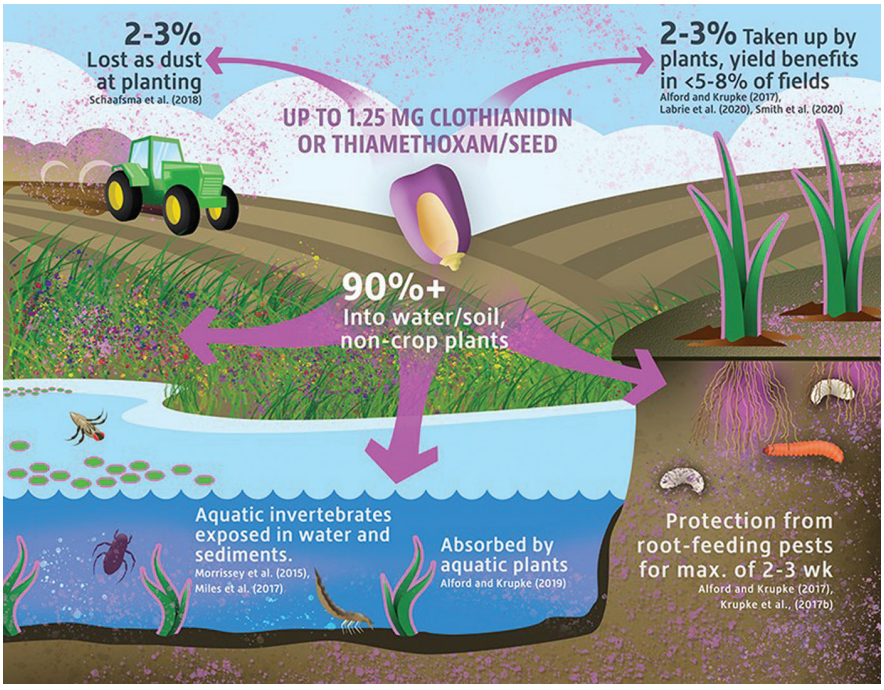

Fig. 2 *A schematic representation of the environmental fate and transport routes of neonicotinoid active ingredients (shown in purple throughout the diagram) that originate from treated crop seeds.*

Second, for anyone who doesn't already know, the European Food Safety Authority (EFSA) banned neonics from use on pollinator-attractive outdoor crops in 2013, then fully banned them from all outdoor agricultural uses in 2018, due to unacceptable risk to managed honey bees and wildlife. Neonicotinoid insecticides are currently the most-used insecticides in the USA and have never been banned from use on any crop in the USA despite the same scientific evidence considered by the EFSA and the EPA (the EPA is the USA's equivalent of Europe's EFSA). In other words, the reason neonics are currently banned in Europe but not banned in the USA has nothing to do with the underlying scientific evidence. Instead, it has to do with sociopolitical differences in how scientific evidence is considered by the public, regulatory agencies, and policymakers.

With this context, I was intrigued to be contacted in 2018 by a representative from the New York state governor's office inquiring if the Dyce Lab would be willing to develop a risk-benefit analysis for neonics in collaboration with an economist. The goal would be to synthesize all existing scientific evidence on economic benefits of neonics to farmers and risk to pollinators in the five major application contexts in which they're used: field crops (corn, soybean, wheat), fruit crops (e.g., apple, strawberry, blueberry), vegetable crops (e.g., squash, pumpkin), ornamentals, turf and landscape management (e.g., golf courses, ornamental plant nurseries), and forestry (e.g., control of hemlock woolly adelgid in forests).

Over the course of two years, we compiled a mountain of data on neonics, eventually publishing our 432-page report in June 2020 (Grout et al., 2020) and making it publicly available on the Dyce Lab website. You can read the full report at the following link: **https://cornell.app.box.com/v/2020-neonicotinoid-report**. And for those of you who don't want to wade through 432 pages (I totally understand!), we also wrote a 4-page summary and published it in ABJ in September 2020. You can read the 4-page summary at the following link: **https://blogs.cornell.edu/mcartlab/files/2020/09/09-McArt-article_September2020.pdf**

What were the major take-home messages of the risk-benefit report on neonics? Bees foraging in and near corn and soybean fields planted with neonicotinoid-treated seeds are likely to experience harm that will negatively impact their populations. This conclusion is based on 96 exposure assessments from the peer-reviewed literature. Less is known regarding risk in tree fruits, vegetables, and turfgrass and ornamentals settings, but the data indicate that sometimes there's substantial risk to bees and sometimes there's not in these non-field crop settings.

In terms of benefits, in most application contexts there's good evidence for economic benefits when neonics are used. This should not be surprising; pesticides control important agricultural pests. But economic benefits are surprisingly rare in field crop settings. Of the 613 field trials we compiled from the literature, only 12% of cornfields planted with neonicotinoid-treated seeds experienced greater yield compared to fields planted with untreated seeds. And only a portion of these 12% of fields made up for the cost of the treated seed such that farmers experienced an economic benefit. We found similarly low yield and economic benefit numbers for the 573 fields that compared neonicotinoid-treated soybean seeds to untreated seeds.

The results described above reveal that very few corn and soybean farmers are actually benefiting economically from using neonicotinoid-treated seeds. Yet nearly all cornfields and the majority of soybean fields in the USA are planted with neonicotinoid-treated seeds. This is a problem for pollinators for the reasons described above, but it's also a problem for farmers' pocketbooks because they're frequently paying for something they don't need.

Do studies published since June 2020 support these conclusions? Yes. I can't summarize every study here, but on the pollinator risk side of things one excellent study published last year in the journal Proceedings of the National Academy of Sciences (Janousek et al., 2023) found that decline of the western bumble bee (*Bombus occidentalis*) was linked to neonicotinoid insecticide usage across the western USA (see Figure 1). This is one of many studies that continue to find evidence of harm to bees from neonics.

On the economic benefits side of things, three studies published in late 2020 stand out. First, a review paper in Frontiers in Sustainable Food Systems (Krupke and Tooker, 2020) did a nice job distilling the problems with neonicotinoid-treated corn and soybean seeds. Their summary can be found in Figure 2, where they show that only 2-3% of the neonicotinoid treatment is taken up by the corn or soybean plant, more than 90% escapes to the environment, and yield benefits occur in less than 5-8% of fields.

These low yield benefits from neonicotinoid-treated seeds are even

smaller than we found in our 432-page review, and they come from the two most comprehensive field studies that have ever been conducted on this topic. Labrie et al. (2020) monitored 84 corn and soybean fields in Quebec for four years, finding that neonicotinoid-treated seeds improved yield in less than 5% of fields compared to untreated controls. Smith et al. (2020) monitored 160 corn and soybean fields in Ontario for four years, finding that neonicotinoid-treated seeds improved yield in 6% of soybean fields and 8% of cornfields, compared to untreated controls. Smith and colleagues concluded their paper with the following statement: *"These data highlight an opportunity for reducing input costs, environmental loading, and nontarget effects without adverse outcomes for Ontario producers."*

Well, the scientific evidence on this issue is pretty darn clear. Perhaps so clear that we should stop using neonicotinoid treatments on corn and soybean seeds? That's what New York Governor Kathy Hochul decided to do in December 2023 when she signed the Birds and Bees Protection Act (S.1856-A/A.7640). This evidence-based legislation will prohibit the use of neonics on corn, soybean, and wheat seeds, as well as all outdoor ornamental plants and turfgrass.

But here's the catch. The new law for seed treatments was revised at the last minute by Governor Hochul and won't go into effect until 2029. That's five years from now. An additional revision introduced an exemption process where some farmers will be able to use neonicotinoid-treated seeds if they qualify. In other words, more than a decade after Europe banned neonics for all outdoor agricultural uses due to unacceptable risk to managed honey bees and wildlife, one state in the USA will have a law prohibiting use of neonics for some outdoor uses, with exemptions.

Why is there such a difference between Europe and the USA on this topic? And why won't the new law for seed treatments go into effect until 2029? In a word, disinformation. None of my European scientist colleagues who do research on neonics or other pesticides have experienced the level of pushback that regularly occurs on this topic in the USA. I find that informative. While I don't have space here to fully address every relevant difference between Europe and the USA (this article is already quite long!), I can share that disinformation is one of the big ones.

Julie Suarez

Photo 1 *The author of this article testifying at the NYS Assembly Legislative Hearing on Neonicotinoid Pesticides on September 20, 2021*

I'll spend the rest of this article describing two examples of scientists who successfully muddied the water on neonics in New York, likely influencing the 5-year delay and exemption process for field crop seed treatments in the Birds and Bees Protection Act. There were others who contributed to this effort, but my intention here is not to exhaustively describe all efforts. The reason for passing along this information is simple: to improve public awareness.

Example #1: Bayer scientist attempts to discredit our risk-benefit report at the NYS Assembly Legislative Hearing on Neonicotinoid Pesticides. In September 2021 I was requested to give public testimony on our risk-benefit report to the NYS Assembly. At the hearing I described the major results of the report, as well as relevant studies published since June 2020, and answered questions from legislators for about 45 minutes (see Photo 1).

During my testimony, I also addressed previous testimony from Dr. Sean McGee, a scientist from Bayer (a company that makes neonicotinoid insecticides). Dr. McGee was asked to give his opinion about the risk analysis we conducted in our report. He replied as follows:

> *It was incomplete. In the absence of a defined approach, they just said 'there's the presence of a neonicotinoid, there must be an effect.' That's not risk assessment. That's presence equals hazard. If that were the case, none of us would be drinking caffeine. Caffeine is ten times more toxic to humans than neonics are, but we drink it every day.* (NYS Assembly Public Hearing on Neonicotinoid Pesticides)

There's a lot to unpack in that quote, but the important point that needed to be addressed was the approach we took in our analysis. In fact, we did not take a "presence equals hazard" approach as Dr. McGee indicated. Instead, we compared all quantitative neonicotinoid exposures that have been documented in the scientific literature (e.g., 15 parts per billion clothianidin in pollen collected by bees foraging near cornfields) to quantitative neonicotinoid levels that scientific studies have shown either do or don't have effects on bee physiology, behavior, and reproduction (e.g., hives dosed with 15 parts per billion clothianidin have queens with reduced egg laying rates, while hives dosed with 5 parts per billion clothianidin experience no adverse effects).

In other words, we followed the standard risk assessment approach by comparing quantitative exposures to quantitative hazard. Dr. McGee, who said he had reviewed our publicly available report extensively before his testimony, misled the NYS

Scott McArt

Dear Editor,
A recent article in the *New York Post* by Henry I. Miller claims our report, *Neonicotinoid Insecticides in New York State: Economic Benefits and Risk to Pollinators*, has "serious credibility problems" due to five scientific "flaws". I'm writing to say that simple facts, which anyone can read by clicking the link to our report, discredit Mr. Miller's claims.

The first supposed flaw is that our report "lacked any consideration of actual pesticide-use patterns by New York farmers". In fact, pesticide use patterns for every crop grown in New York were exhaustively summarized on pages 69-118. The second supposed flaw is a "reliance solely on lab studies rather than real-world field data". In fact, real-world field data comprise every single data point in our risk analysis (pages 185-283). The third supposed flaw is "confusion about key concepts such as the difference between toxicity and risk". In fact, the difference between toxicity and risk is described in detail on pages 34-35 and readers are reminded of this difference throughout the report. To be extra clear, we even made a half-page diagram on page 35 that explains how toxicity is different from risk using pictures and arrows. The fourth and fifth supposed flaws are "failure to understand the difference between systemic and foliar uptake" and "absence of any new research". Both are false statements, which probably comes as no surprise at this point. Feel free to check out pages 19, 66-68, and 200-227 if you'd like to see the proof.

There you have it. Five supposed scientific flaws in our report, five succinct explanations why Mr. Miller's claims are baseless. The pesticide company Monsanto previously drafted an industry-friendly article for Mr. Miller to publish under his own name. One has to wonder if a pesticide company drafted this disinformation article for Mr. Miller as well.

Scott McArt, PhD, Associate Professor, Cornell University

Photo 2 *My response to a New York Post article penned by Dr. Henry Miller concerning our 432-page risk-benefit analysis for neonicotinoid insecticides. The Post declined to publish a factual correction of Dr. Miller's article, so we published our response on Twitter.*

Legislature and said our approach was *"presence equals hazard."* If this had been true, I would have agreed with him that we hadn't performed a risk assessment. But it wasn't true.

This means a Bayer scientist misrepresented a fundamental aspect of our risk assessment in an attempt to discredit its legitimacy. I pointed this out to the NYS Assembly members at the start of my testimony, then tried to explain why his claims were incorrect. But the damage was already done. Trying to succinctly explain scientific methods to non-scientists at a public hearing isn't easy. Also, I was attempting this explanation 30 minutes after Dr. McGee had made his comments and the Assembly members had thanked him for his time.

In my opinion, Dr. McGee succeeded. He sowed doubt within the NYS Legislature over whether they should trust me and our 432-page risk-benefit report. As we've seen time and again, doubt is a powerful ally for companies that are trying to avoid regulation by obscuring scientific evidence. Indeed, at the height of tobacco industry scrutiny in the 1970s, one tobacco executive who was leading his company's disinformation campaign famously wrote in an internal memo: "*Doubt is our product*." The Birds and Bees Protection Act failed in the NYS Senate in early 2022.

Example #2: The New York Post spreads doubt from a professional disinformer. Upon hearing that many New York field crop growers felt there was a "controversy" about neonic seed treatments, several extension professionals tried to engage more thoroughly with farmers on this topic in 2022, listening to concerns and communicating the science. Because look, I get it. When your neighbors and your friends and everyone else uses neonicotinoid seed treatments, it must feel strange when some Ivy League honey bee guy says you probably don't need them. Even if all of his field crop entomology colleagues at other universities agree.

At the same time, some legislators decided to continue pursuing a slightly revised bill. In fall 2023 it was becoming clear that the Birds and Bees Protection Act had a good chance of becoming law. It had passed the NYS Senate and Assembly in summer 2023 and was waiting for the governor's approval. Predictably, the attacks on scientific evidence intensified.

One particularly egregious article called "New York farmers' futures depend on a single Hochul decision" was published in the New York Post by Dr. Henry Miller. Dr. Miller is a former medical researcher who uses his scientific credentials to try and influence public opinion via the popular media. He's a former fellow of the Hoover Institution, a public policy think tank that promotes personal and economic liberty, free enterprise, and limited government. And he's a current fellow of the Competitive Enterprise Institute, a libertarian think tank that advances the same principles.

Dr. Miller has precisely zero expertise on neonicotinoid insecticides. But that didn't stop him from claiming in his New York Post article that restrictions on neonicotinoid-treated seeds would *"devastate New York's farmers and upstate communities."* He went on to claim:

> *Activists misled legislators with a single Cornell report from 2020 with serious credibility problems that implausibly concluded neonics are unnecessary. Its flaws included the absence of any new research, confusion about key concepts such as the difference between toxicity and risk, reliance solely on lab studies rather than real-world field data and the failure to understand the difference between systemic and foliar uptake. It also lacked any consideration of actual pesticide-use patterns by New York farmers.*

The problem with these claims is that every sentence is false. In other words, Dr. Miller was deliberately attempting to undermine trust in scientific evidence and scientists. Because of this, we contacted the Post and asked if they would publish a factual correction. They declined. So, I published a response on Twitter which can be seen in Photo 2. This response and the discussion it precipitated can be viewed at the following link for anyone who's interested: **https://twitter.com/McArtLab/status/1724152562449035762.**

I was hopeful this would set the record straight, but the Post decided to double down. A few weeks later their Editorial Board published an article imploring Governor Hochul to veto the Birds and Bees Protection Act. They again relied on Dr. Henry Miller's false credibility as a scientific expert to bolster their claims:

> *As molecular biologist Henry Miller notes, the ban would devastate New York's farmers and upstate communities, who depend on "neonics" to*

protect their crops. … A similar ban in Europe caused enormous crop damage. As for bees, their numbers nationwide have actually increased*, despite the widespread use of neonics.*

Again, the problem with these claims is that every sentence is false or misleading. The 2018 European ban on neonicotinoids was problematic for some crops that are not part of the Birds and Bees Protection Act. For example, some British canola farmers experienced losses immediately following the restrictions (See "The Agronomist: British Oilseed Rape following the EU Neonic Ban," August 2019 ABJ), though canola production has rebounded and currently exceeds pre-restriction levels in the EU (Eurostat, 2024). More importantly, Europe's neonic restrictions have not caused enormous crop damage to corn, soybean, or wheat crops (i.e., the only three crops that are part of the Birds and Bees Protection Act). In fact, total production in millions of metric tons for those three crops remained consistent between 2016 and 2022 (Eurostat, 2024).

But Europe is not North America, so let's see how identical restrictions on neonicotinoid-treated corn and soybean seeds have impacted yield in the Canadian provinces of Ontario (restrictions implemented in 2017) and Quebec (restrictions in 2019). These Canadian provinces border New York and have similar growing conditions and pest problems. In the six years since neonicotinoid-treated seeds were restricted in Ontario (2017-2022), corn grain yield averaged 166 bushels per acre and 9.0 million metric tons were produced. Conversely, in the six years before neonic seed treatments were restricted (2011-2016), corn grain yield averaged 159 bushels per acre and 8.4 million metric tons were produced. Soybean yield followed a similar pattern, with an average of 49 bushels per acre and 3.9 million metric tons produced post-restriction (2017-2022) compared to 47 bushels per acre and 3.5 million metric tons produced pre-restriction (2011-2016). Similar yield patterns were observed for corn and soybeans in Quebec pre- and post-restriction (Statistics Canada, Table 32-10-0359-01).

In other words, corn and soybean yields in Ontario and Quebec have increased since restrictions on neonicotinoid seed treatments were implemented. This evidence confirms what scientific studies have shown again and again on this topic: Very few corn and soybean farmers actually benefit from using neonicotinoid-treated seeds. In Quebec, a panel convened to discuss this topic revealed that some corn and soybean farmers have chosen to forego insecticide seed treatments altogether, while others are using a different seed treatment that's more pollinator-friendly: anthranilic diamides (Quebec Farmer Panel, 2024).

Photo 3 *Posting a response on Twitter to Dr. Henry Miller's article in the New York Post caused one scientist to amplify his disinformation. Dr. Stuart Smyth is a professor at the University of Saskatchewan.*

As for the claim about increasing numbers of bees, this is a common tactic to obscure scientific evidence on this topic, which I pointed out on my lab's Twitter account (see Photo 3). In fact, there are ~20,000 species of bees worldwide and many other non-bee pollinators. While the number of domesticated honey bee colonies has in fact been stable (USA) or increasing (worldwide), those numbers have historically tracked with demand for pollination as well as general interest in beekeeping, not environmental stressors. Many wild pollinator species are in fact experiencing well-documented range contractions and population declines. For example, the New York Natural Heritage Program recently conducted a four-year study and determined that *"using conservative criteria, 38% of New York's native pollinators are at risk of extirpation from NY."* Their study is located at the following link for anyone who's interested: **https://www.nynhp.org/projects/pollinators/**.

Why is Scott spending so much time on disinformation? Shouldn't scientists "stick to the science" and leave the rest up to policymakers and the public? Well, it turns out there's a fundamental problem with that approach. If scientists don't defend scientific evidence, that evidence will be obscured. We have nearly 80 years of experience showing that uncontested disinformation from a small number of scientists will obscure the truth, delay beneficial interventions, and result in harm to humans (e.g., tobacco, leaded gasoline, vaccines) and the environment (e.g., DDT, acid rain, fossil fuels). This means it's actually irresponsible for scientists to sit on the sidelines and allow the obscuring of scientific evidence to occur.

In the case of the Birds and Bees Protection Act, the article from Dr. Miller was well timed in fall 2023.

Indeed, the New York Farm Bureau forwarded Dr. Miller's article and the Post Editorial Board's article to their constituents on December 14, 2023, along with the quote: *"Follow the science — and veto the pesticide bill."* By reading this article, you have access to the same science as the Farm Bureau on field crops seed treatment risks and benefits. Do you think vetoing the bill follows the science?

The Farm Bureau used similar language in their December 18 letter to Governor Hochul, co-signed by more than 70 organizations and business groups, imploring her to amend or veto the Birds and Bees Protection Act. On December 22, 2023, Governor Hochul amended the Act by delaying implementation of neonicotinoid restrictions on corn, soybean, and wheat seeds for five years, and including exemptions.

After this decision, the Farm Bureau wrote to their constituents:

> *New York Farm Bureau worked tirelessly with the governor's office and our agricultural and agri-business partners to avert a legislative agricultural ban on neonicotinoids and treated seeds. We are pleased to report that Gov. Hochul put forth many chapter amendments that will allow farms to continue to have access to these important risk management tools. She signed the Birds and Bees Protection Act (S1856-A/A7460) a short time ago, but with many favorable provisions in place for farmers that the legislature signed off on, greatly changing the bill compared to the one that had passed last June.*

A key take-home message from people who study disinformation is that it can be combatted. But this requires effort. It requires engagement from scientists, an informed public that's willing to think critically, and lots of communication. With this article, I'm trying to improve on my end of the bargain by being an engaged scientist and communicating. I think my communication could have been better over the past 3.5 years. If I had communicated the scientific evidence more effectively and called out disinformation more forcefully, I wonder if we'd be in a different place with neonicotinoid insecticides in New York.

But I'm only part of the equation. I also invite you to become informed on this topic. And your friends, their friends, and their friends. Together, scientists and informed citizens can be a powerful team that promotes evidence-based policies. When it comes to pesticides, this is increasingly important in the USA. Because until we have an adequate pesticide risk assessment process overseen by the EPA, promoting evidence-based pesticide policies is likely to be needed in all states, not just New York.

Until next time, bee well and do good work.

Scott McArt

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