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Beyond Bees, Neonics Damage Ecosystems—and a Push for Policy Change Is Coming

Scientists point to the long-term negative impacts of neonicotinoids, and advocates hope a regulatory overhaul will help.

BY LISA HELD

FEBRUARY 2, 2021

Last June, a national partnership that tracks honey bee population declines released the results of its annual survey. Between April 2019 and April 2020, beekeepers reported losing nearly 44 percent of their colonies, the second highest rate since the first survey in 2010.

For people paying attention to the many studies that have been piling up over the last decade documenting the devastating effects of neonicotinoids on the powerful pollinators, the news was far from surprising. Neonicotinoids—or neonics—are now the most widely used insecticides in the world, and nearly all conventional corn and soy farmers in the U.S. plant seeds coated with the chemicals. As the evidence that neonics kill pollinators by attacking their nerve cells has grown stronger (with industry-funded studies also confirming harm), multiple publications have warned of an "insect apocalypse."

Governments around the world have stepped in. The European Union first restricted neonic use in 2013 and then banned the use of three common neonics on all crops in 2018. Then, last January, the EU declined to renew the registration of a fourth. France has banned five chemicals in the family. Canada has proposed phasing out three and will make a final decision pending a scientific review expected to conclude this spring.

So far, the U.S. has not followed suit. In early 2020, the Environmental Protection Agency (EPA) filed an interim decision to allow the continued use of the five most popular neonics, with minimal restrictions.

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At the same time, some environmental groups and lawmakers have sharpened their criticism, drawing attention to the issue with new intensity through lawsuits and legislative campaigns. Two different bills that would restrict neonic use were introduced at the federal level in 2020. At least one, the Protect America's Children from Toxic Pesticides Act (PACTPA), will be reintroduced to a new Congress this year and also includes what advocates say are meaningful updates to EPA pesticide approval processes. Meanwhile, several state-level efforts are picking up steam in New York, California, and elsewhere.

Scientists and advocates say regulation can't happen soon enough, given the recent body of research that points to harms that extend far beyond pollinators to widespread soil and water contamination affecting aquatic animals, birds, mammals, and entire ecosystems.

Daniel Raichel, a staff attorney at the Natural Resources Defense Council (NRDC), said that when he first started working on neonic regulation in the summer of 2016, he thought colleagues who referred to the issue as a "second *Silent Spring*" were exaggerating. "I don't believe that anymore," he said. "We're getting a new study every couple of weeks, and the scale and scope of the ecological problems that we are seeing is off the charts. It's a bee issue for sure, but really, it's an ecosystem issue. It's an everything issue."

At the same time, there is new evidence that the most widespread use of the insecticides—as treated corn and soy seeds—does not lead to yield or income increases for farmers, evidence that runs contrary to industry claims. Still, the same study found some fruit and vegetable farmers do depend on the chemicals, and most farm groups oppose banning neonics on the basis that it could impact their production.

"I think the lack of options for some farmers is pretty striking," said Mike Stranz, the vice president of advocacy at the National Farmers Union (NFU). "We can't deny the seriousness of the situation that comes with impacts on pollinators, but there are also some serious implications for farmers. That's the balance that needs to be struck here." The American Farm Bureau Federation, which is more closely aligned with agribusiness interests, goes further, by explicitly opposing any ban on neonicotinoids and downplaying research that shows risks to pollinators.

A field of oats and soybeans. (Photo CC-licensed by Elvis Kennedy)

Meanwhile, environmental experts say saving pollinators and ecosystems will take more than a new administration or state and federal bans of a few individual neonics. Real solutions may also require closing regulatory loopholes, updates to the EPA pesticide registration process, and a more concerted effort to help farmers deal with insects in less toxic ways.

“The problem is urgent enough that we really need to be doing everything that we can,” Raichel said.

Beyond Bees

Neonicotinoids are pesticides that can be sprayed directly on plants, but most are built into seed coatings. Because federal agencies only track pesticide applications, and farmers are planting instead of spraying the chemicals, reliable data on their use is sparse.

Studies have estimated between 80 and 100 percent of conventional corn acreage and 34 to 44 percent of soybean acreage are planted with treated seeds. In many places, companies no longer offer untreated seeds as an option. When they do, they often reduce the amount of replant coverage they offer if farmers choose the cheaper, uncoated seeds, driving farmers to choose the more expensive, coated seeds as a form of insurance. Neonics are also used on fruit and vegetable crops and in landscaping and pet products, and they are injected into trees to fight invasive pests.

Their systemic nature is what makes them different from past insecticides and so toxic to bees, explains Greg Loarie, an attorney at Earthjustice. Whereas an insect might have escaped unharmed if not caught in the direct line of spray before, bees can now be exposed to neonics by merely visiting a field, and they can bring the chemicals back to the hive, spreading damage.

“There’s really no way that they can avoid the insecticide when it’s infused into the plant and into the pollen and nectar,” said Loarie. Because neonics bind to nerve cells, they can affect bees in various ways. Neonic exposure can weaken a honey bee’s immune system, making it more susceptible to diseases. At certain doses, it can affect their cognition and flight ability, both of which are essential to hive maintenance. It can also affect reproduction.

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Now, research shows the chemicals are not just infused in the plant, they’re also broadly contaminating the environment, exposing many organisms. As plants grow, they

only take up between 1 and 10 percent of the chemical in the seed coating. The rest remains in soil and leaches into groundwater, and eventually, waterways.

Water samples taken from nine streams during the 2013 growing season in the Midwest detected neonics at every site. A 2020 NRDC report found one neonic, imidacloprid, has been detected in surface waters throughout New York State and in 30 percent of groundwater samples on Long Island. In many cases, the levels surpassed the EPA's own benchmark for long-term harm to aquatic invertebrates.

And evidence that neonics harm those invertebrates, like plankton, is increasing. One 2019 study out of Japan demonstrated a surprisingly clear link between the introduction of imidacloprid to rice fields and the disappearance of zooplankton in a nearby lake, which ultimately led to the collapse of the fishery there because other species that ate the plankton also decreased.

Canada's final decision on banning neonics will depend on evidence its health agency is analyzing related to harms to aquatic insects. "The thought is that these pesticides might already be hollowing out our ecosystems from the bottom up," Raichel said. "Our entry into this was pollinators, but . . . that ripples up the food chain."

In August, the first long-term, national-scale study of neonicotinoids' impacts on bird populations was published by researchers at the University of Illinois. They found neonic use had a large effect on population declines, especially among grassland birds in the Midwest, Southern California, and the Northern Great Plains. A 2017 study found that imidacloprid affected sparrows' ability to gain weight and migrate properly.

New research points to effects on mammals, too. A 2019 study found that deer exposed to imidacloprid at levels they'd encounter in fields had an increased risk of birth defects and lower rates of fawn survival

Deer in a canola field. (Photo CC-licensed by Jim Choate)

In January 2020, a coalition of scientists and health professionals sent a letter to the EPA expressing concern related to emerging research linking chronic neonicotinoid exposure through food and water to various negative health outcomes in humans, including developmental and neurological damage. While the evidence is far from conclusive at this point, the extent of human exposure warrants serious attention, they said. One 2015 survey found that half of the U.S. population over three was exposed to neonics, and a 2018 Environmental Working Group analysis found residues of at least one of the three most common neonics on more than half of the potatoes, spinach, and lettuce the group tested.

Stranz said that NFU's farmer members take potential harm caused by pesticides seriously, and the organization's official policy supports "public research of effects of pesticides, such as neonicotinoids, on bee colonies, especially related to Colony Collapse Disorder" as well as "encouraging collaboration between the pesticide manufacturing and pollinator industries to educate applicators and producers about the potentially harmful effects of pesticides on pollinator populations."

But he pointed to the limited choices many farmers are often presented with, both due to concentration in the pesticide industry and farmers' actual needs to control pests.

In June, researchers at Cornell University published an exhaustive 432-page assessment of neonic use, risks, and benefits in New York. They found that for farmers in the state growing certain fruits and vegetables, neonicotinoids provided consistent benefits. Berry growers were able to control root weevils and sap beetles, and treated seeds helped control seedcorn maggots and aphids that attacked snap beans.

"Neonicotinoids are the best available product for control of Swede midge, a major pest of cabbage and other brassicas," the researchers found. "Growers would likely struggle to control this pest in the absence of imidacloprid and acetamiprid."

All this begs the question: What are farmers doing in Europe, where growers no longer have the option to use neonics?

The European Example

As far back as 2008, individual countries in Europe began limiting the use of neonicotinoids, and in 2013, the governing body of the EU implemented restrictions on agricultural uses across all member states, specifically due to an assessment of the risks to bees. Its decision to then fully ban the use of clothianidin, imidacloprid, and thiamethoxam in 2018, said Dave Goulson, was based on this emerging understanding of how the chemicals spread out and persisted in ecosystems.

“One of the things that wasn’t known in 2012 was that neonics accumulate in soil and contaminate non-crop vegetation. People didn’t realize at that point that even if you’re not using them on flowering crops, if you look at the pollen the bees are collecting [from nearby plants], it’s still full of neonics,” explained Goulson, a biology professor at the University of Sussex. In 2020, the European Commission also decided not to renew the registration of a fourth neonic, thiacloprid.

Because neonics can persist in soil for five years or more and there is no systematic monitoring of insect populations in Europe in place, Goulson said it’s too early to tell if the neonic ban has had any positive effects on pollinators. And whether or not it will lead to healthier ecosystems over the long term is complicated by the fact that chemical companies have already introduced replacements.

“There’s a whole suite of insecticides, some of which look suspiciously like neonicotinoids, but we’re told they’re not,” Goulson said. “They’re all neurotoxins, attacking the same bit of the insect brain. And we don’t know whether they’re actually going to be any better.”

One of those star next-generation insecticides is called sulfoxaflor, and it’s also now used in the U.S. Like its neonic cousins, the EPA found sulfoxaflor presents numerous risks—such as increased mortality—to honey bees. However, the agency deemed the level of risk acceptable.

After sulfoxaflor was approved by the EPA in 2013, Earthjustice sued and a court ruled in its favor, saying the agency had not adequately evaluated those risks. The agency reapproved sulfoxaflor on limited crops in 2016, and then, in 2019, it brought back all of the original uses. In 2020, two different lawsuits were filed to fight that decision, one by Earthjustice on behalf of beekeepers and another by the Center for Food Safety and the Center for Biological Diversity.

The Future of U.S. Policy?

Those lawsuits could determine the fate of a neonic replacement. Meanwhile, in the U.S., the EPA is also currently conducting a registration review—a process required to re-examine the safety of pesticides every 15 years—of the five most common neonics. As written now, it would allow for nearly unrestricted continued use. Advocacy groups including the NRDC have filed comments, and depending on the outcome, Raichel said his team might litigate.

Given all of the pressing issues facing the agency’s new leadership, he and other experts said they doubt a major change of course on the neonics issue would occur right away, or even be procedurally possible. But a final review decision is due further

down the line. “My assumption is if the agency were going to correct course, October 2022 would be a likelier time that that would happen,” Raichel said.

Congress is a somewhat different story. While legislation banning neonics is unlikely to get far because of the political power of agribusiness companies, multiple lawmakers are moving forward with introducing bills. In 2019, Representative Earl Blumenauer (D-Oregon) re-introduced the Saving America’s Pollinators Act, which would cancel the registration of a long list of systemic insecticides including common neonics and sulfoxaflor. A spokesperson for Blumenauer said that he “remains committed to protecting critical pollinators” and will likely re-introduce the act during the 117th Congress, “though timing of that has yet been determined.”

Regardless, he’ll likely sign on to support PACTPA, which Emily Knobbe, an EPA policy specialist at the Center for Biological Diversity, said will soon be re-introduced in the House by Representative Joe Neguse (D-Colorado).

While it’s not completely clear who might take up the Senate companion bill, she says it’s “the Center’s main policy priority in the pesticide arena, since it is by far the most progressive pesticide reform to have been introduced in recent years.”

The bill bans other highly toxic pesticides in addition to neonicotinoids, and it also makes changes to EPA processes. It sets up a petition process for citizens to submit information regarding dangers of pesticides, which the agency would then be required to review. And it requires EPA to conduct an emergency review of pesticides deemed unsafe by Canada and the European Union.

Knobbe said both of these tweaks would force the agency to review more independent science, as opposed to basing approval decisions primarily on studies provided by the pesticide industry.

Even Stanz, who represents farmers’ interests at NFU, agrees that relying on private research provided by chemical companies is less than ideal. “Public research and a common-good approach certainly is far more attractive and far more useful to our members, given the influence that comes from being part of those companies,” he said.

“We’ve been in the room multiple times when EPA has referred to industry as ‘their client.’ That’s backwards. Industry is not the client here,” Knobbe added. “The environment and the health of people should be the client.”

That issue is mentioned often by experts, and Loarie said more fundamental changes that focus solely on safety rather than a risk-benefit analysis are needed for chemicals

like neonics to be properly evaluated. “EPA is allowed to decide that there’s a risk *here*, but that risk is outweighed by the benefits over *here*. That is very, very problematic,” he said. “It’s gotten to the point now where I think EPA often looks at the pesticide and says . . . ‘This new pesticide is a reasonable risk because we hope it will replace these older pesticides that are even worse.’ That’s not a good spot to be starting from.”

Advocates are also trying to close loopholes in neonic regulation at the state level. Last year, New York legislators introduced a bill that would stop the use of popular neonics for five years while the state re-evaluated their risks. The bill never came up for a vote.

Even if it had passed, however, it wouldn’t have applied to seed coatings, which account for the vast majority of neonic use in the state. For example, New York has decided not to register the neonic clothianidin for outdoor use because of its risks. In 2014, however, 38,000 pounds reached the state’s farm fields in the form of treated seeds. “We’re hoping to get an amended version [of the bill] introduced next session that addresses that issue,” Raichel said.

That lack of regulatory power over seed coating has also shaped policy in California, but NRDC and others are pushing to change that fact, and the state is doing the most so far to regulate neonics.

All of these efforts are a long shot, and resistance from agribusiness is powerful.

But perhaps the most compelling evidence that sentiment could shift among farmers toward some sort of regulation comes from the aforementioned report out of Cornell. While researchers found some fruit and vegetable growers might struggle without neonics, for corn and soy farmers who plant treated seeds—the largest use of neonics by far—they found no yield or income benefit compared to farmers using alternatives or no insecticides at all. Past research supports the same conclusion.

In other words, farmers are paying more to use harmful chemicals that don’t deliver benefits.

That conclusion is in line with evidence on how bans on neonics have affected farms in Europe, Goulson said. “The industry claimed that there would be massive crop failures, and it would be an economic disaster for farmers across Europe, and just that just didn’t happen. There’s been no measurable impact . . . on crop production.”

Statistics show overall production of three crops that would have been subject to neonic restrictions starting in 2013—soy, rapeseed (canola), and sunflower seed—have increased or stayed fairly level.

Raichel likens the use of neonics to antibiotics in meat. “There’s this massive proactive use,” he said. “It’s contaminating the environment, harming bees—and not helping farmers.” In fact, he added, “it’s not helping anyone, except for chemical companies’ profits.”

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