

Neonicotinoids: From Your Fields to Your Streams

Commonly Used Seed Coatings For Pest Management Threaten Freshwater Ecosystems

IN BRIEF

Neonicotinoid insecticides, sometimes used as seed coatings for pest management, move from agricultural fields into surrounding creeks and streams where they can harm aquatic life.

Originally intended as a safer alternative to spraying crops, research indicates that neonic-coated seeds may not improve crop yield in many situations. Furthermore, other research has documented neonicotinoid toxicity to non-target and beneficial insect species including pollinators.

In a new study from Stroud Water Research Center, scientists captured neonicotinoid-laden



Research Highlights

- Establishes the movement of neonicotinoids from coated seeds into surrounding streams.
- Documents reductions in neonicotinoid release after coated seeds are discontinued.
- Reports continued lower-level export of neonicotinoids to receiving streams for years after neonicotinoid-coated seeds are excluded.
- Provides evidence that neonicotinoids are highly toxic to mayflies, a critical indicator species in freshwater systems, confirming acute toxicity to macroinvertebrates reported as early as 2013.



Neonicotinoids enter waterways from runoff on farms using seeds coated with this common class of insecticides.

surface runoff from agricultural fields long after farms stopped using neonic-coated seeds. Although the researchers found the release of both neonicotinoids they studied (clothianidine and imidacloprid) varied and generally declined, runoff still contained measurable concentrations of neonics originating from the seed coatings four years beyond their use. They also confirmed even low concentrations are highly toxic to mayflies, an important freshwater macroinvertebrate and component of the aquatic food web. Neonic-coated seeds are pervasive in commercial agriculture; yet their environmental impact may be significant, particularly to aquatic systems.

“The current use of neonicotinoid seed treatments in soybean and other crops far exceeds pest pressures.”

– PENN STATE EXTENSION

RESEARCH

Stroud Water Research Center scientists began studying the release of the neonicotinoid insecticides clothianidine and imidacloprid in paired agricultural watersheds in 2019. Conventional agricultural practices prior to 2019 included the use of neonic-coated seeds in both watersheds. Beginning with the 2019 growing season, one field discontinued the use of coated seeds and began cover crop planting. Controlled simulated rainfall events within both of the actively farmed fields produced runoff containing measurable levels of clothianidine and imidacloprid. Data from experiments the researchers conducted in 2022 suggest agricultural fields continued to release imidacloprid four years after its use was suspended. Storm concentrations of clothianidine declined in a stream receiving

runoff from the field with non-coated seeds. The researchers conducted laboratory toxicity experiments to observe the impact of each insecticide on mayfly survival, and standard 96-hour acute dosing tests confirmed the toxicity of imidacloprid on mayfly hatchlings. The researchers then reared survivors of the 96-hour exposure period and exposed them to imidacloprid concentrations of 7 micrograms per liter, a low concentration that resulted in nearly 100% mortality.

FINDINGS

Water-soluble neonicotinoids move from seed coatings to soil and surface water. Neonics are present in runoff from fields with coated seeds. Neonics persist in the soil and are released into surrounding water during storms for years after their use is discontinued. Some evidence suggests concentrations are



Three kinds of neonicotinoid insecticides were banned in Europe in 2013 over concerns about their impact on pollinators. The ban was expanded to all field crops and three additional neonics were added in 2018. Photo: Brian Preston Photography

starting to show a decline. Imidacloprid is highly toxic to mayflies with both lethal and observable sublethal effects.

SIGNIFICANCE

Aquatic insects – macroinvertebrates – are important components of the aquatic food web, ultimately supporting fish and bird populations in surrounding ecosystems. Neonicotinoid toxicity is greater when more than one type of neonic is present in freshwater streams, suggesting toxicity studies to date that examined the toxicity of a single neonic insecticide underestimate the potential harm in aquatic systems.

What You Can Do

- Discontinue use of neonicotinoids now to improve water quality in the short and long term.
- Seek out alternatives that have been identified, including non-chemical pest control alternatives.
- Contact a local Cooperative Extension, which may have resources to assist farmers who want to maintain or improve crop yield and soil health while also reducing the risks associated with neonicotinoid insecticides.

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Stroud Water Research Center produces the trusted science needed for successful stream and river conservation while fostering people’s passion for the water in their lives. Go to stroudcenter.org to learn how you can help.